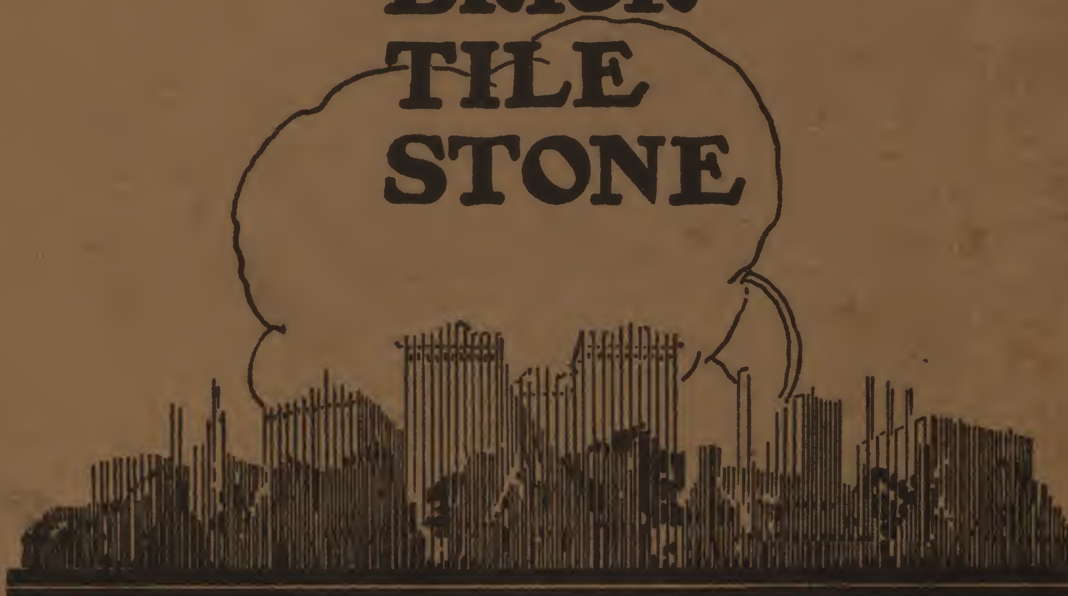
GOOD CONSTRUCTION

WOOD
CONCRETE
BRICK
TILE
STONE



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Good Construction

IN WOOD, CONCRETE, BRICK, TILE and STONE

A portfolio of standard approved Detail Plates with explanatory text

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Basement Windows

In a recent discussion the question as to just what a "small house" really amounted to was glibly joined by "$25,000." Of course, the answer was not quite fair, but to home buyers of unrequited dreams it seems true enough. Further discussion led to charm in the design of the really small house. Where does the money go?

Four years ago I tried to sell my wife a basementless bungalow and went so far as to plan the whole. But we compromised by excavating for a basement and putting the bedrooms above stairs. Likely most architects and builders effect the same compromises, but not always, unfortunately, before the batter boards are down. Perhaps being raised where homes had cellars but not basements has given me a fondness for low elevations. The city house with the basement dining-room irritated me.

Then, too, with the advent of the furnace came another type, on spiles. It is related that an irrational skipper brought his lovely boat into dry dock, immediately cast anchor and went ashore in the small boat. Some hours later he returned to find the dock bailed out and the boat shored. Contemplating the excess freeboard, the red below and the gray above, he was struck with the beauty of it. So he built him a house on spiles (one foot excavation for bilge), red up to the gangway and gray above. Soon after a gale arose and his house, not being in a dry dock, lay over with the weather, the spiles let go, and Neptune (in the shape of a furnace) came up through the parlor floor to laugh at him.

Not all people like houses without basements, but the styles in architecture call for that effect at least. There is some question as to whether this low floor-line principle is really sound when building close to a thorofare or on small lots, since there is the danger of propinquity to the street and to other and larger buildings. Builders consider that, of course, but cannot always dissuade their clients.

The sketches opposite are made to show some of the details in small house work that are worth consideration. Calculating to add charm, the small house, more than the larger one, is apt to run into appurtenances, really impertinences, so the details must be thoroughly considered. The subject is basement windows. Their omission may be a striking feature in the common modern picture, but all houses cannot take sunlight through unseen rear windows. These basement windows are to go into the near side, an approach shot. The question is, can we hole out. Certainly.

The house in the upper right hand corner illustrates a common condition in well-timbered towns where the grades are natural and rolling enough to permit such building. Providing the composition is carried to the level of the basement window sill, eliminating that below water-line appearance, the lines are not spoiled by windows showing at the low grades. This place, in block and added brick, is small and attractive, and provides an excellent basement. But to add a negative in calculating, a frame house on the same grade would very likely carry the first floor joists on a ribbon. If this were done no pains should be spared to insulate the basement walls. An acquaintance once removed all the insulation from heating pipes in the basement of his home which was similarly built, assuring me that basement chill made the lower floors extremely cold.

The second house is low and not all excavated. The walls are shingle and the lines are northern. The two basement windows at the front are placed in a slight dip in the grade and directly below the casements. You will notice that the low eaves will counteract the extra visible basement wall and that the vertical lines at the garage front balance that.

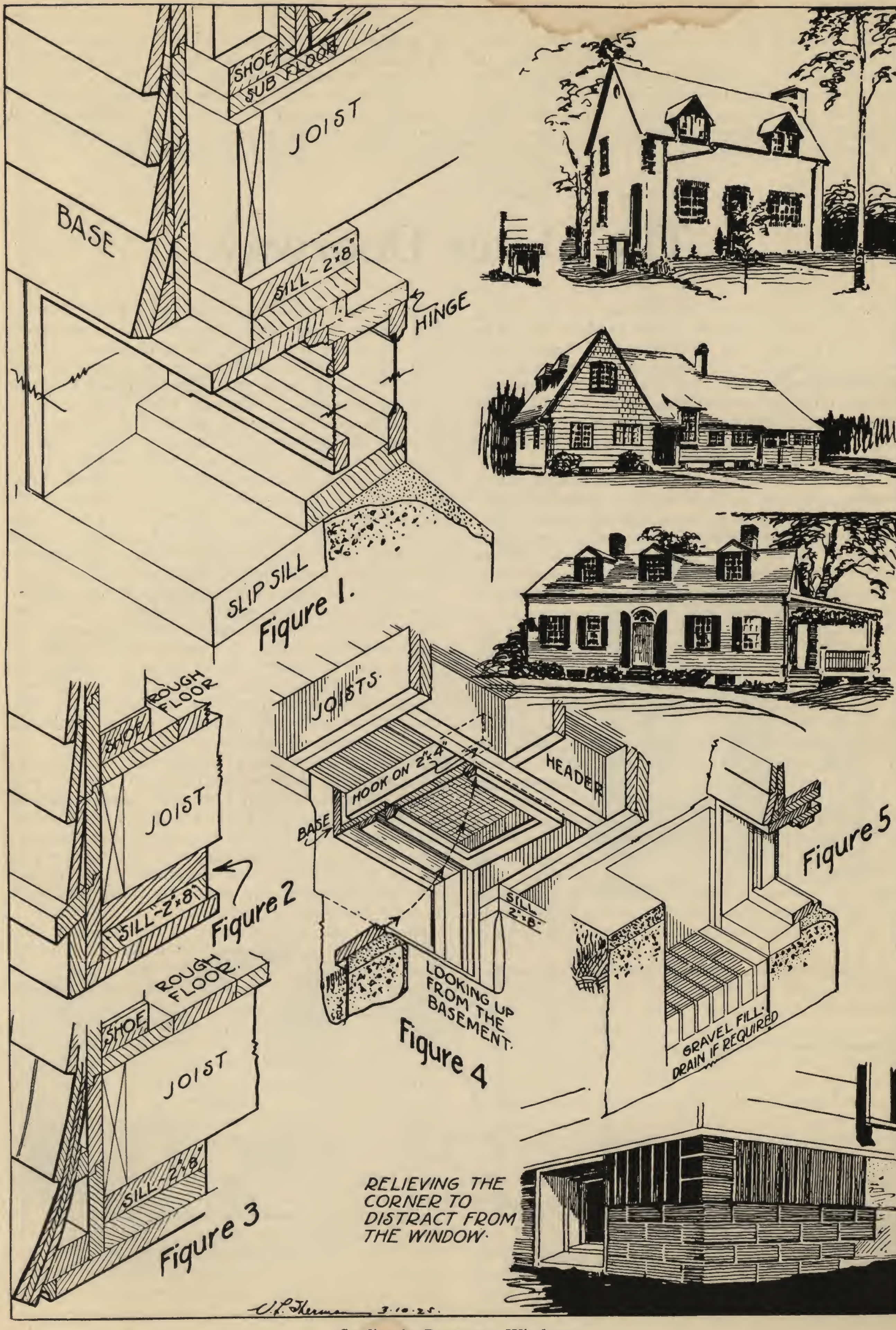
The lower house is an old-timer and one in which basement windows were not at first conceived. Yet the windows at the front of the house do not detract so much, and with the wide porch to lend breadth the floor-line could not well be lower and retain the eave line.

These three houses are real houses, they are not spoiled by basement windows, and there are plenty of other houses just as well brought up. In the first the house wall goes to the grade and includes the window. In the second and third the *baseline is unbroken* though interrupted by grade or shrubs. That may account for it. Suppose the construction shown in Figure 4 had been used. This would have brought the floor lines lower but the cut baselines would have been a great mistake. The header construction should not be used where a broken baseline is conspicuous.

In case the elevation of the house prescribes no visible basement windows, areas ought to be used. Basements should be ventilated and given at least some sun. Figure 5 shows an area. Its makeup may vary but give plenty of space before the window. The area should be neat and unless protected should be well drained. A grating, bought or made of rod and bar, may be sunk in the coping, or attractive palings used. For safety sake, and children, the first is better. For myself I could get along better without the basement than with the areas.

Simple box sill construction is shown above the windows. For neatness and cheapness it seems to be the best. Some see an apparent lack of anchorage. When the question arose in my own case I resorted to the theories of mechanics, wind pressures, side wall areas, projected roof areas, centers of gravity, moments of force and so on. Theory proved, in my case, and the premises are still sound, that even a wind velocity of eighty miles would have no effect, and that is 30 pounds per square foot on the walls of an unanchored frame house. Only one reservation is made. A house exposed and in a territory of high winds is better built if the sheathing is diagonal, giving each piece a grip on the plate but not necessarily on the foundation.

Figures 1, 2 and 3 show different base construction and there are other combinations. The base line with any siding should be distinct and at a proper distance from the grade. The house should



Studies in Basement Windows

not ride high or appear overloaded. The depth of the window from the face of the wall also has its point in appearance. Basement windows deep from without are shadowed and harborers of dirt. Trim, dirty from rain splash, is harder to avoid than dirty windows. Shallow reveals make the window harder to reach from within the basement, but this can be helped by easing the wall back of the sill. By all means use screens. Steel sash is not included in these drawings. Neither are scuttles. The first have easily won a place in house building and some types of the second are still going strong against their competitor the oil pipe. Plain and glazed coal chute windows are now very common.

The Outer Doorway

The mills, I believe, have done and are doing their level best to produce high grade work. The job is not an easy one. Forethought, research and endless patience are the price of the correct production of house parts, and the mills have accomplished much along these lines. But the mill owner cannot pursue the house to heaven or the other place and mill products are as likely to be abused in their use as any other products.

The small house of today is very often a mill product. To this there is not the slightest objection except for the fact that mill products are sometimes abused in their use. From what one sees it is easy to surmise that at least a few appropriate pieces are lost in the shuffle between various houses. In the rush the builder is to be congratulated that there are so few mishaps.

In the old days—that is, in the early days of the last century—building and architecture were largely one job. The experience in one line bolstered the experience in the other. Caution and boldness went along together. To illustrate the point refer to Figs. 1 and 2 opposite. The upper one represents a Grecian moulding of strong projection with the curve in hyperbolic form. This neat outline of section procures a blending shade when we assume the sun's rays to be about 45 degrees. Now, supposing the angle to be about 45 degrees, and a shorter projection required, we must change the curve from hyperbolic to parabolic so as to get an equal softness of shadow contrast under the moulding. The letter "a" in Fig. 2 shows what would have been an hyperbola, and it is clear that such a curve would not produce the beauty of shadow of the lower curve.

Doorways make or break a house about as thoroughly as any particular part. They are to be studied with as much care as any other part. Some try to go by rule and some do not. For the old forms of formal doorways you will find plenty of rules, but the most logical one to my mind is to start with the proportion of 22 to 9, height and breadth, laying out the stiles as units of the breadth, and sticking to it. The doorway may be large or small, but it should not be unreasonable in its outline.

The entire doorway may be the feature of the house without any harm, or it may be very inconspicuous. There is a home in Knoxville, Tenn., with a plain plank door and raw beam lintel, but it is certainly a beauty. On the other hand, some architects can use such a doorway as is shown in Fig. 6, and on a small brick house, and get away with it in great style. That doorway belongs to a house in Sussex, England, and gives a combination with lights at the side. The whole is in white with the usual dark door. Large doorways will fit small houses when properly designed and placed.

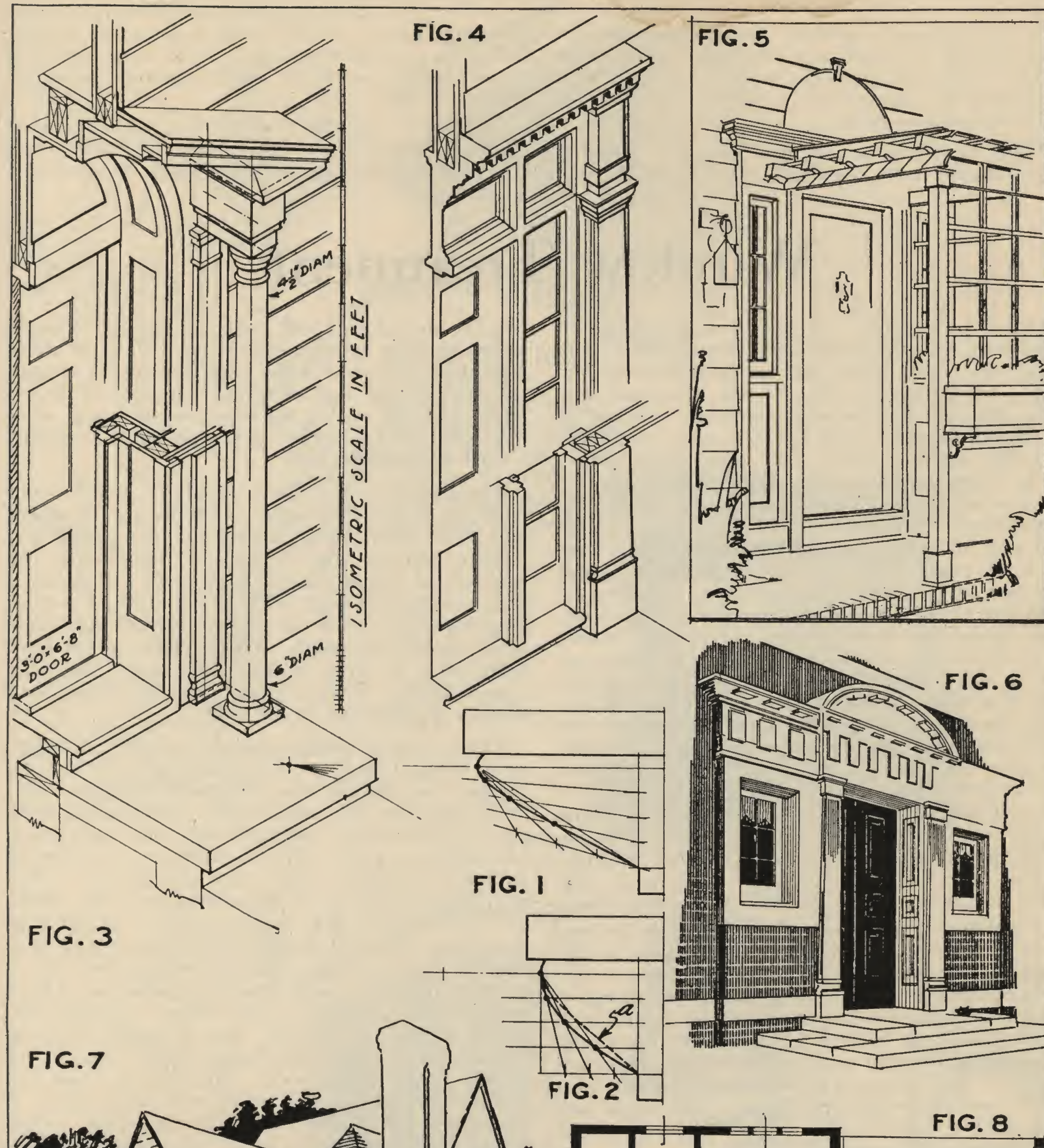
Figs. 3 and 4 show the makeup of two types of Colonial doorways. Both are fairly light in form when compared to some of the modern approaches, although the drawings give them a rather cumbersome appearance. They are in isometric with a scale alongside for measurement if desired. The only suggestion we make is that the height of the door be increased to 6 feet 10 inches or even 7 feet, if the width of 3 feet is retained. The resulting inequality on the inside will give chance for modest decoration that will not be out of place.

All of these doorways are more or less formal, those least with the window lights at the sides. But full dress does not always spoil the party, and a fair instance of this is the doorway in Fig. 5. At a guess we should say that at one time this was a very prim piece of work. It has all the earmarks of exact beauty without being precise. The semicircular pediment "gives it a vertical motif, while it retains its openness."

Possibly I am entirely wrong, but someone else had a different motive and cornered the doorway with a pergola. Again I may be entirely wrong according to rule, but when I looked at the photograph from which I made the sketch, and that was some time ago, the lightness of the form, pergola and all, coming from that combination of straight lines and impending arc, made me think that some are very fortunate with results.

There is one main feature in the doorway that is sometimes entirely overlooked by the builder. That is its environment, inside and outside. To illustrate the point I have very deliberately helped myself to part of a house. Figs. 7 and 8 show a little more than half of the original. The pedigreed doorway is there. The left hand is the working unit of the home and provides simple partitioning with an accommodating floor plan. The lighted stair-hall with the cross openings make a great combination for appearance as well as utility.

When studied there seems to be very little to that gable end except one door, three windows, and a flat porch roof. Beyond that there was either great capacity by the architect or remarkable luck. Considering the contrast thrown on the door by the row of shuttered windows at the right, eaves above them and shrubs below, and the long roof marked off by the heavy chimney, the probability of chance grows slight. That doorway was built for the house.



Studies in Doorways

So, in building a doorway the question is: will it provide an entrance or a threshold? Is it to be a street doorway, or at the end of a path? Will it be seen as a feature of the house, or partly hidden in its surroundings?

Along with the artistry of doorway building comes another part, construction. What effect will shrinkage have? Is the house to be moist enough in air to prevent checking? If by any chance a Dutch door is used, can the youngsters swing on the lower gate?

And last, does the illusion of a splendid outer doorway vanish as you step inside the house?

"If I have failed the fault lies wholly at my door."

Window Treatment

This is June. Out of doors is best of course, but if not that, we can at least keep open house. There is but one thing better than an open window and that is an open door. So French doors are here taboo, but may their numbers increase. Except for the hearth no part of the house is more celebrated than the window, and on the other hand only a smoky fireplace can cause more cussing than a balky window. Balky windows, faulty in outlook, appearance, or openness should be a thing of the past, and fit to be taxed, as they once were. Now we have every advantage, lot restriction, lighter structure, and a fad for ventilation. Nothing to want but taste. Those responsible for the noticeable advance in house design in the last twenty years have spent much of their time on windows. Garish wall papers, lit with chromos, are replaced with cool walls decorated from within and without with windows. The musty company parlor with the blinds never opened, and with wax flowers under the glass bell, gives way to an airy living room, real flowers within smelling range, and blinds, if any, which probably couldn't be closed at all, thank heaven. Sound advice, if you must have workable blinds, get awnings. The only place for a louvre is in an attic or a bedroom door. All of us in city, town, or country are blessed with open windows.

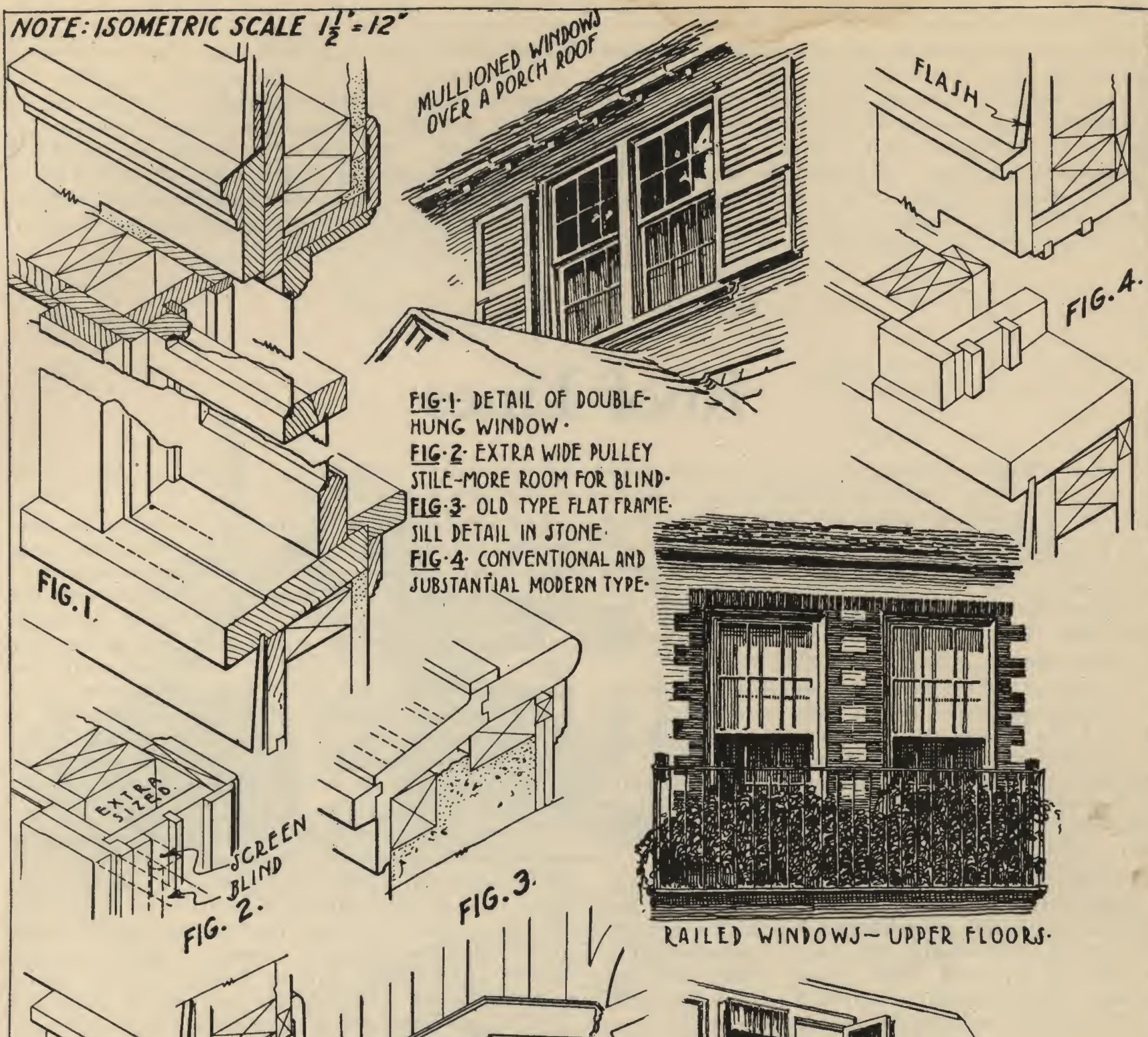
It is difficult at times to decide between the two types of window, double-hung (guillotine), or the casement window. Each has its advantages. And the casement in its swinging out or swinging in has its advocates in both directions. On speculation the double hung window is by far the safer, and it can be made fully as attractive as any casement window. But it cannot be used with as much freedom or with as much small effect. The larger and high double hung window is now replaced by the French door.

The double hung window becomes a unit of wall design. It can be placed to emphasize a plain wall or to collect the lines about it. This is shown in the upper sketch opposite of the windows over a porch roof. They are close to the eaves, mullioned, and silled near the porch roof. The windows point to both in a polite way. The sketch of the railed-in windows below shows the possibility of bringing the eye to one point, or to a group of points. Such methods are effective from the outside and are very attractive from within. They claim appreciation. Double hung windows of today are just as good as they ever were except when the parting strips and stiles are painted soft wood. I have heard they should be hard wood, oiled. Headers should be strong and sills permanent. Here shrinkage, poor flashing, and fitting take toll. No double hung window should ever leak a drop or wobble, or stick. Metal weather stripping overcomes many of these difficulties. A room I use was cold in the winter, the sash rattled, and sung like rigging. Now the room with its twelve big windows is warm even in a gale and I can raise the windows as easily as I used to raise the roof.

The figures 1 to 4 show details of double hung windows in isometric, with a scale for measurement of 1½ in. equal 12 in. if desired. Notice the difference between Figs. 1 and 4. They show the contrast of design in structure. Fig. 2 shows a deeper section as built with 2 by 4 studs, a section allowing ample room for closing and locking blinds when screens are used. Fig. 3 shows a sill used with stone or brick walls. The lintel with this type is hidden. The window is really colonial and lends a dignified air to the wall.

The variety in design using casements is apparently without limit. Loss of wall space is less regretted when lost to these delightful windows. Refusal to argue the advantages of swinging them out or in probably identifies my own preference, but both are good. Fig. 5 shows an in-swinging casement window with a two-piece sill. Drip mouldings should never be omitted and they should be let into the jambs to a good fit. Metal drip mouldings and sill joints are an advantage, and some claim that weep holes below are too. But a weather tight casement window depends more than ever on the stability of the frame and even the house frame. A priming coat of paint left long enough to discover the leaks, which can be recalked, helps, but a poorly built frame, case and sash which shrink and warp will make of it a stationary affair that keeps nothing out. This croaking should not be taken too seriously, however, for no builder will pass the buck to a window. The sash of the casement which swings in is of course better protected. If not too large it is not in the way and can be used to direct air currents. Curtains and shades fastened to the sash are out of the way when the window is open.

Now the use of casements which swing out is in keeping with house design across the Atlantic. The English are not bothered with flies as we are. Screens, avoided there, are unavoidable here. But this need not detract from appearance or operation. A group of casements swinging out is an inviting sight. Almost like an open door. They proclaim a ready entry to the house whenever you have been out of doors long enough. Casements naturally open out. Fig. 6 shows a casement window section in stone or brick fitted for a window seat. Such



Studies in Windows

a plan is desirable when it can be used. As hinted before the sight of the out of doors has taken its place in interior decoration. Make all the use of it possible. The sketch to the left shows a similar plan in a frame wall. In this instance the casings are plain except for the projection above. The transom idea is very practical, and it might be said that a transomed kitchen window is the thing.

A long story could be made of the hardware for window use. The manufacturers have everything on the counter, and for those who are ultra the hardware shops supply the trade. Not long ago I visited a firm that was turning out door and window hardware for a new theatre. It was largely hand work and beautiful in design. And the pains taken for mechanical correctness was surprising. A great deal is added in beauty and comfort when the window hardware is first class.

Roof Lines

To come within the space allowed for it, this chapter must be brief. Structure, aside from cornices, will not be taken up except on one point; that is the use of toe nails. The prevailing increase of roof lines in small homes has led some to this habit in extending roof lines along walls. Rafter tails and lookouts should not be merely toe-nailed to the sheathing. It is a bad habit and its ease engenders promiscuous use, which is probably worse.

In contrast, let me mention a small stucco cottage of extreme plainness which daily catches my eye as the train passes. Withal the cost of the property is probably less than six thousand. There is an unusual mark about it. A row of Lombardy poplars put before the hedgerow would transport the whole three thousand miles from its nearest neighbor. Just a small house with a wonderful roof.

Elsewhere in this book you will find plenty of information on roof framing in different forms. Here we will stick to gable and hip with a hope to dip into gambrels later. To begin with the gable, or fork, or inverted ship's frame, build from the ground. Improvement in material and method gives the house-part wall height and the line at the eaves becomes prominent. But still the roof is the main portion and only later is the frame under-drawn, forming a ceiling below the joists.

Still later in the hurry, we forget the roof is more than a water-shed and we deal in lines for expediency only. Hence the characterless flat hip roof with the pipy chimney. These houses furnished dwelling space, and nowadays furnish contrast for their better-built associates, but the necessity is gone and ignorance of better stuff is inexcusable.

There is one type of hip besides that of the attractive western bungalow which has always appeared worth while. As a roof this flat overhung type shown in Fig. 6 is not easy to handle. Like the Swiss chateau the house must have a setting and a unity with it. Generous proportions and a solid chimney, with a yard and trees and a perspective from the road, make it look anything you wish to make it, either neat or burly. But the rafters must show weight.

Anticipating these is the Colonial roof with its carefully turned eaves. The roof surmounts the house but seems a part of it. Note in Fig. 3 the care taken to fit the profile to the wall, and how it is carried down the wall in Fig. 4. The old aristocrats knew more of Grecian mouldings than they did of mythology. Their importation of architects left its impress and the care of the old times lends us the copy plates for today.

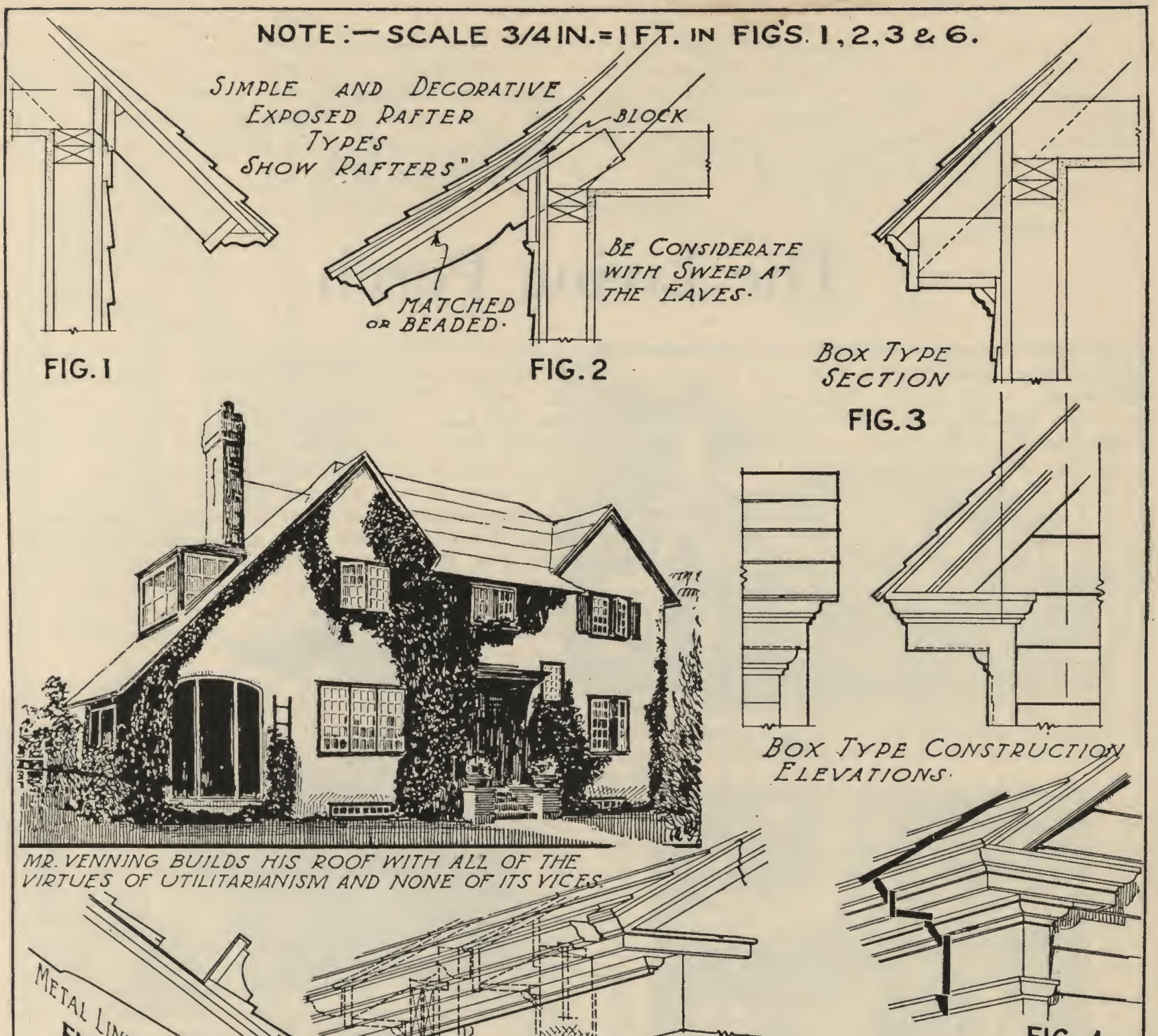
One of the failings in such an eave line is carelessness in hanging gutters. To eliminate poor chance some eaves are set in near the return as shown in Fig. 5, the molded box gutter carrying the line along the length of the roof. As a rule most gutters are larger than is necessary and pitched too steep. Such gutters will of course intercept the lines and throw them out of kilter just as much as a slanting down-spout will throw a house out of plumb. Water will run best in a "V" gutter and a pitch of 1/16 inch per foot should be plenty. A large gutter is prone to clog with snow and ice, and its capacity means slow melting in a thaw.

One more point: On wide eaves ice sometimes coats the shingles up to the house wall. Unless it melts away during the thaws an accumulation will force the surface water or rain back up under the shingles. Guard against this by running the lining high under the shingles. Simple hanging gutters and V edge-gutters can be made to blend easily with the roof. They should carry both color and line. Steep composition or real slate roofs will take an edge gutter with very good grace.

Figures 1 and 2 show the exposed rafter eave which is common and often very attractive. The first is simple, if cheap, and on small dwellings adds enough in detail to give lightness in outline. The one to the right is more elaborate or decorative, and parallels the old country thatch edge in tendency. Overhang is usually more than Fig. 2 shows and for this reason care should be taken to fit the show rafters for their job. The matched lining gives the necessary thickness and is parallel with the projected under-edge of the shown rafter. The sheeting is blocked above this rafter for a fair curve only. Don't exaggerate. Open timber cornices may be used on frame or masonry.

A simple roof has special attraction. The sketch opposite is of a house designed by Mr. Frank Venning, architect, for his father. This place is near enough and old enough to have come under a critical eye from every point of the compass. Invariably the critical stage passes. From one direction you may approach from the top of a hill and first see the roof over the trees. Then your eye becomes covetous.

According to tradition the ridge parallels the street. The architect balanced the height and breadth to a nicety and then threw in long slope to



Studies in Roof Lines

the south for contrast, breaking that again with a sun room. The chimney rises past the slope and you have a home. When the architect and the builder had these chores done, the owner began operations, and if he hasn't outdone both his predecessors by providing a fitting local landscape, he has at least run them a close race.

This leads to a point that cannot be too strongly emphasized. A roof should be simple but not stupid. The lines should be artless and unstudied, even if you have to study them again and again. Build the roof to the house.

The Living Porch

Although one may say that a rose by any other name will smell as sweet, there are reasons why the terms "sun-parlor," "solarium," and similar terms are not adequate. First, most parts of the north temperate zone are intemperate in weather, excepting, of course, the celestial climates of the coasts. Strictly, then, sun-parlors would be limited in use. The second term has an ending which suggests "aquarium," for the goldfish who do not live in small houses, and "sanitarium" which too truly follows intemperance.

Now this added, sheltered floor space should fill more than one requirement. It should be the buffer state between the extremes of weather and the well regulated home. As suggested above it is best suited for those who need such a buffer and not for those who can put faith in the weather. It is only related to the patio and the tea-terrace. The living porch should be airy in the hot weather and free from excessive house heat in the cold weather. Better still, it should be so well built that it affords complete protection from the weather while having the greatest possibilities for taking advantage of the weather.

The living porch should be open to the sun, which means there is little advantage in using the north of the house for this addition unless it is for appearances from within or without. The south side of the house is generally to be preferred since any cutting off of the sun from that side affects the rest of the house least. A south porch should be open well up to the ceiling line for ventilation. A south porch should be open on three sides. There is no sufficient excuse for cutting into one side.

One of the very best of additions to a house is to have a south living porch with a children's bedroom or a nursery over it. No youngster ever got an over-dose of sunlight in the home. A south porch, open on three sides, will catch very nearly every breath of air that stirs. So in the summer when the breeze falls off at sunset you can generally depend on a south porch for that circulation you need so much on hot evenings.

A westerly porch has what you might call negative values. Its advantages accrue rather to the house than to the porch. Such a porch does not cut off the morning sunlight from the rest of the house, and morning sun is best for housekeeping purposes. During the winter a west porch will thoroughly insulate the west wall of the house. North winds are cold but the west winds are colder. Some of its positive values are its location in relation to the yard, and its location as regards outlook. For the first you will notice that a westerly porch does not interfere so much in planning the yard for flowers and shrubs.

Flowers, so I understand, do better when open to the east and south than when exposed only to the west. They need the light and warmth but not the heat. Then as to the second. Most of us hardly have time to perch our feet on the railing and relax in an easy wicker before supper. And who cares to look toward the east after supper excepting those who dote on the moon. Such people wouldn't be content with any porch unless they had it to themselves. The western sky at sunset and the waxing moon are much better seen from this side. That is more than I intended to say for the west porch. Compared to the south and to the east it needs a lot of boosting.

The east porch is in many ways best of all. Mornings it has the sun, afternoons it escapes the heat. It is thus a great compliment to the dining room into which it may open. (I have known of cases in small homes wherein the dining room was to all appearances a living porch, wide open in the summer, and bright and fresh in the winter. An auxiliary heater was used for the cold days, and in one case an open fire made it especially attractive.) Compared to the other two sides an east porch is by far the cooler in hot weather, besides it escapes the strong winds and drenching rains that sometimes necessitate closing up the others.

At the top of the opposite page there are two figures, Figs. 1 and 2, which contain a point or two I wish to emphasize. Many living porches are built so as to throw the chimney between two French doors. Perhaps there is no happier arrangement. But in doing this faulty construction sometimes develops. A wall split by a chimney is not always of the strongest, and two large and additional openings do not serve to strengthen the wall. A lack of bound-up strength in the house wall next the porch may play havoc with the house part as well as the addition.

In the case shown, the floor levels of the living room and the porch are the same, but the porch ceiling is dropped to the level of the ribbon that supports the living room ceiling joists. This change makes the window height relatively greater and allows more run to the porch roof without interfering with the second floor window sills. The lintel of the French door is a pair of two by fours on edge and a truss effect gives the necessary stiffness to the floor above and upper wall.

In Fig. 2 it can be seen that the plate for the porch roof is a double two by four carried over the window span by a two by ten on edge. The contractor that is building this house has a cordial dislike for casement windows, but I know that his casement windows are as weatherproof as can be made. His idea is to protect the casing from any strain.

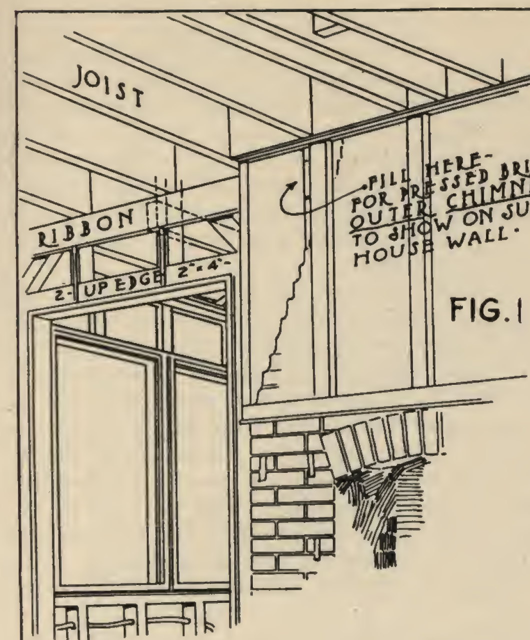


FIG. 1

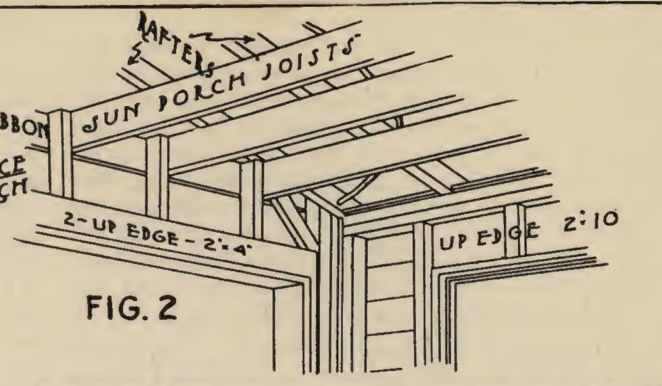


FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

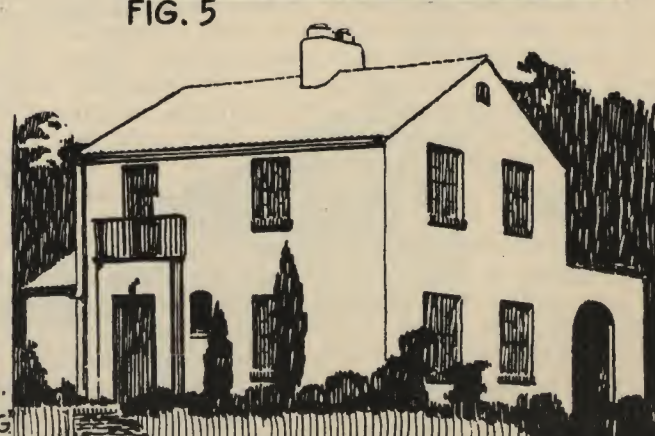


FIG. 7

FIG. 1 FRAMING PORCH CEILING, INSIDE.
FIG. 2 FRAMING PORCH CEILING, OUTSIDE.
FIG. 3 ATTRACTIVE INCREASE IN LIVING ROOM.
FIG. 4 A GREAT ADDITION WITHOUT THE "MODERNIZING".
FIG. 5 THE USUAL AND EFFECTIVE METHOD.
FIG. 6 A BREEZY LIVING PORCH FACING EAST.
FIG. 7 THE MORE PRIVATE LATIN PORCH
INDICATED TO THE RIGHT AT THE REAR.

O. L. Sherman 7-7-25.

Fig. 3 (page 11) is next in line and is used because it goes to show what can be done with proper additions. Of all the sterile combinations there is none more so than the box walls, hip roof, and chimney in one corner. But here we have a house fronting east, with an oddly proportioned front. The living room is all windows and the owner having his appetite whetted for the out-of-doors gorges himself by extending the living room right out into the yard. The excess is remarkably fine from the inside and mitigates a box from the outside.

Fig. 4 is my idea of a house to live in. The place is much older than its present owners, and when some of the youngest carpenters cut through the wall to make the addition they were rather surprised when they uncovered the heavy timbers and saw part of the anatomy of the old house. This porch is to the south and gives off the dining room with one door into the front hall.

Fig. 5 shows the generally accepted porch. With the broad side of the house west or east probably no better porch could be had for that type of house. The only fault might be on the finicky side that it seems too solid in its separation from the rest of the house.

Fig. 6 is an open porch of little detail. Regardless of flies and mosquitoes it is spoiled if glazed or screened. But such a porch if placed on any side but the north is the focus of enough air current to drive away either of these pests. If it is on the north it is a cool delightful spot in the summer, and the fly and mosquito hang about the warmer sides of a house. Besides this you will find that this type of porch will fit almost any house and from almost any angle.

Fig. 7 is after the Spanish style in stucco and tile. True to type the living porch is secluded, but with a gate that seems bigger than the wall it occupies. This porch or pavement or patio is a little below the level of the living room floor. Two French doors open to the east from the living room onto the porch. The gate to the south admits plenty of air, and for a small house the open French doors at the end of the living room greatly increase the livableness of the room. The porch is close enough to the kitchen to allow its use as a dining room whenever company makes the breakfast nook too small.

The living porch is the antithesis of the old "den." With the advent of the motor car and the radio and other rejuvenating elements the old man can't afford enough grouch to seek the seclusion of a "den."

The Dormer

"You see some traces of our doings here. Salisbury Cathedral from the north. From the south. From the east. From the west. From the southeast. From the northwest."—Mr. Pecksniff.

The dormer, like Mr. Pecksniff's Salisbury Cathedral, should be taken from many angles, two at least. You will observe that the sketch, Fig. 1, has a pernicious, flat look. Fig. 2, which is just as stiff in line, is different. You see the outside. Unconsciously you assume the inside.

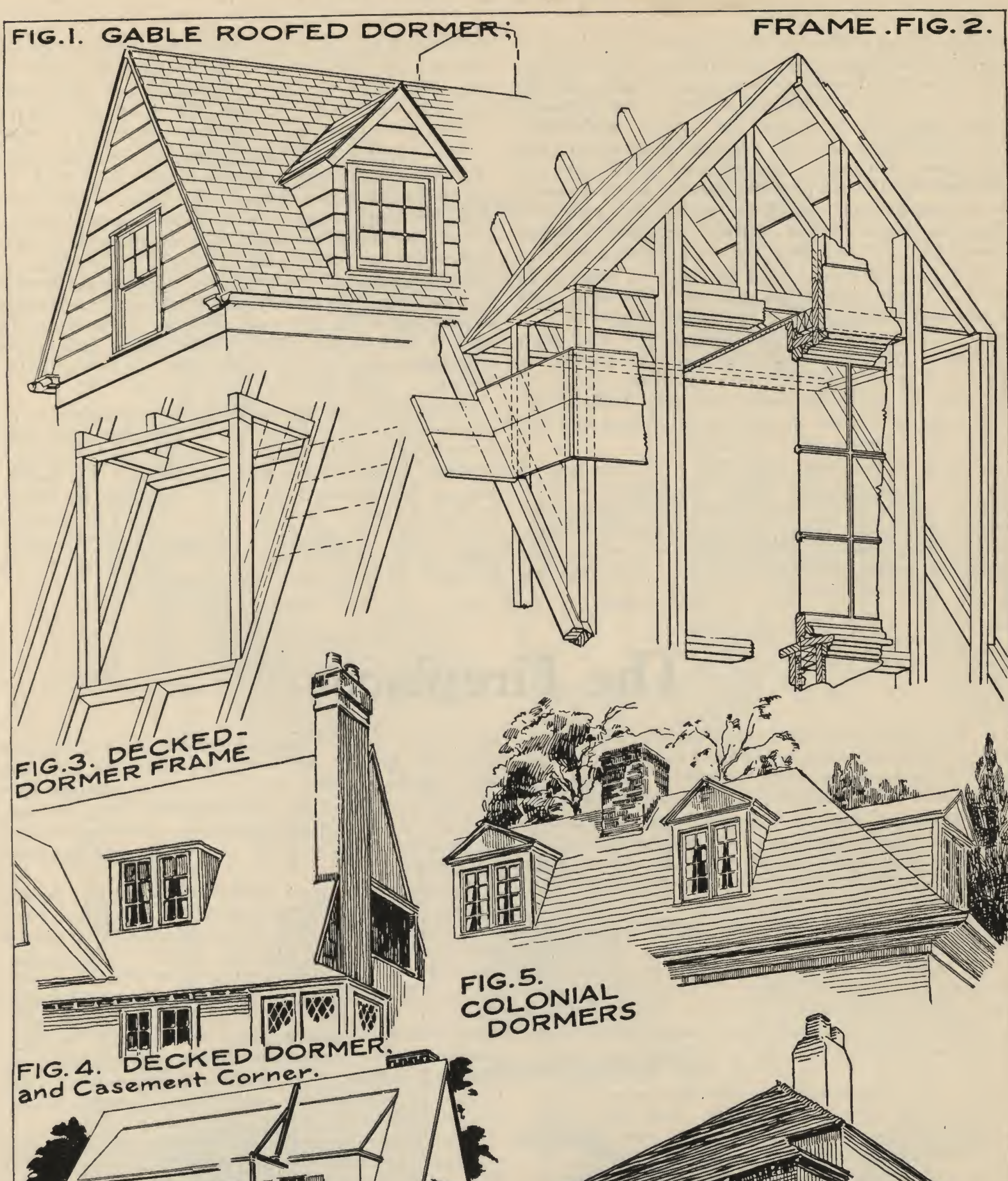
When a house is considered the same holds in a slightly different way. One eye is physical and the other mental. You see the outside. Unconsciously you assume the inside. When, as in Fig. 1, there is no character, or reason, or even a suggestion of anything within, then your mental vision registers a blank, and depth is lost. It looks flat. You wonder, perhaps, why such a dormer is put where there is so little headroom. Ergo, it's an attic. Then why put such a hole in the roof to provide a dormer. This is all cogitation as your thoughts bounce from the flat surface after you have really appraised the house.

Before taking up the large dormer as shown in Fig. 6, the smaller ones should be considered. Start with the bungalow. This type was not meant to be two storied and yet for very sound reasons the attic should be made habitable, that is, lighted and ventilated. The bungalow runs naturally to a low roof, often a hip roof, with a hip roofed dormer at the front. The dormer is small and is more of a light than otherwise. It doesn't imply anything, and it is not obtrusive. But run the roof as a gable, long side forward, and insert a shed roof dormer, and the attic of the bungalow is given a room about the size of the dormer. A cramped appearance results unless the lines are very carefully thought out. When they are the roof is not of the dormer class.

The dormer in Fig. 1 is common pitched with the roof, narrow for its apparent height from the floor, and of no particular use as regards its size. The siding fits ill against the shingles and it looks misplaced. Fig. 4 shows a decked roof dormer in different circumstances. This is well up from the floor, wider, and lighter in structure. It adds to the roof rather than subtracts. The same thing might be said of the roof and dormers shown in Fig. 5.

Like most folks my own judgments are tinged by tradition. These colonial dormers come from the "top story," half mansard, half hip roof of the old country and are indicative of high walls, narrow streets, and attic rooms. But the colonials who, as a rule had plenty of ground, put them to a different use, and their attics were not for sleeping. So the dormer has become not dormant. A typical house with fairly high eaves will take colonial dormers in great style, but the roof should have enough formality of line to prevent a contrast with the dormers. It may be noticed that the heavy chimney topping the dormers in Fig. 6 has rather too homely an appearance for the roof.

The dormer then should fairly match the roof, and if its face rises from the house wall (as it should have in Fig. 1) it should match the house and roof. It is then a roof projection. Such a projection is not always a dormer, but in its present day use the dormer classes with it. Take the shed roof dormer of Fig. 4. Then drop to the corner casements in the same sketch. The extended eaves provide a break and spread in the lines and cover



Studies in Dormers

a sort of oriel. Now go down to the bay in Fig. 7 (page 13), which escapes the oriel only by its lack of corresponding floor space, but sets off the double hip roof and increases the breadth of the wall. You will notice that the comparatively narrow bay, lower roof, and upper roof all unite in emphasizing the main roof. Dormers, windows, and roof shapes are all used for the purpose of putting room location to advantage and taking advantage of windows. Dormers should be put to their very best use, but should be omitted if they are of really no use.

In Fig. 6 there is a long dormer. A miss is as good as a mile so it isn't a gambrel. The main roof is retained and the house remaining gabled in outline. The house wall is low and the roof high pitched. The class is typical and the dormer is not too big to spoil the roof. If there is one to the rear, so much the better, for their bulk is seldom combined when looking at the house and the second floor rooms are well lighted.

So long as the dormer has lost its trade mark of the loft, it should be used with relation to the entire house and not merely as dead-light in the null of the roof. Framing the dormer is of considerable importance. Weak framing is responsible for leaky roofs and sagging roofs. The framing shown in Fig. 2 may be unnecessarily heavy but the dormer should be tied up in itself well enough to take the place of the cut rafters. In this same figure the sill could rest on a two by four set up to take the short foot rafters the same as a ridge.

The framing may be changed to suit the pitch of the roof, its weight, and probable snow load. A dormer of ordinary breadth will not weaken the roof but with more than ordinary spread means should be taken to insert a well supported plate under the cut rafters as in Fig. 6. Partitions in such cases are to be made use of and the dormer roof becomes a secondary roof or truss. The dormer of size must be tied into the roof as well as the roof is tied to the plates since weight subtracted from the main roof is more than made up in the dormer.

Usually the dormer studs are carried down and supported by floor joists. If single rafters are used as trimmers these studs can be set in far enough to allow a seat for the roof sheathing. The sheathing on the dormer wall can be diagonal as shown in dotted line or level as shown. The first closes the triangle but has less spiking-hold on the studs. The dormer should not depend so much for its strength on its roof or wall sheathing.

The Fireplace

It has been said that mankind in general can forgive all of the improvements in the design of the home if the fireplace is left. And that was not said by a brick manufacturer. The fireplace, after a short period of rest on the advent of the gas-log, has come back to its own. The open fire is the one thing left that hooks us up with the pleasures of the gods through Prometheus and the stolen fire. That is not so far-fetched either. One season of cold weather deprived of a real fireplace may convince you.

The subject is a rather broad one to begin with and even antedates chimneys; it is connected with many phases of building; and it is so truly a matter of sentiment that we will cast the sentiment aside for serious business in order to get the best results.

The chimney is one of the main features of a home. Its construction should not be arrived at without some care in the design. For the smaller houses which we are considering one chimney should be enough for the necessary two flues for the heater and the fireplace. In localities where masonry is relatively cheap two chimneys may give added attraction from the outside, but between one large homely chimney and two smaller ones it is better to take the first.

Fireplaces are meant for warmth, and even for heat, first. They are meant as an element of decoration, a very important point. And they are meant for ventilation. They may easily be made to embody all three provisions. They may range from the humblest of hobs to the most imposing, tall, smoke-bemantled structures. Somewhere within the range is the size and type to fit.

Figure 1 is the important figure on the opposite page. This sketch represents an average fireplace in section. The chimney or fireplace base starts just below the hearth and shows the ash-dump opening. The chimney proper rises from its foundation free of the house, and we will suppose that one side carries the flue from the heater, and that the remainder is empty enough to provide ash space for the winter.

The chimney is free of the house but the hearth should rest firmly on an arch and against a two-membered header. The ash-dump should be placed well back and flush with the hearth. The cheeks, base and back of the fireplace are shown in fire-brick. This is largely a matter of choice although there are some ordinances against the use of anything except fire-brick. The back of the fireplace tilts forward to meet the throat which should be long and narrow. The throat should be pretty well toward the face and provided with a damper, which can be operated by means of a screw or a poker.

The damper plays a very important role. It will regulate the draft and consequently the heat, it will stop a windy chimney when its howl isn't part of the chorus, and it will protect the house against flies in the summer time. There is another feature also to be noted. If by chance the smoke or wind shelf is inadequate, the damper will protect the hearth and floor against sooty ink spots during a hard rain.

This leads to the smoke shelf. As a matter of fact if coal is burned it should be called the soot shelf. The theory is that when a fire is started and the warmed air rises from the fire it must overcome countering cold air in the chimney. Also, when the air is gusty some drafts find their way down the flue. Unless some shelf and baffle is provided, the cold air, rain, soot, smoke and heat may emerge

FIG. 1. FIREPLACE SECTION.

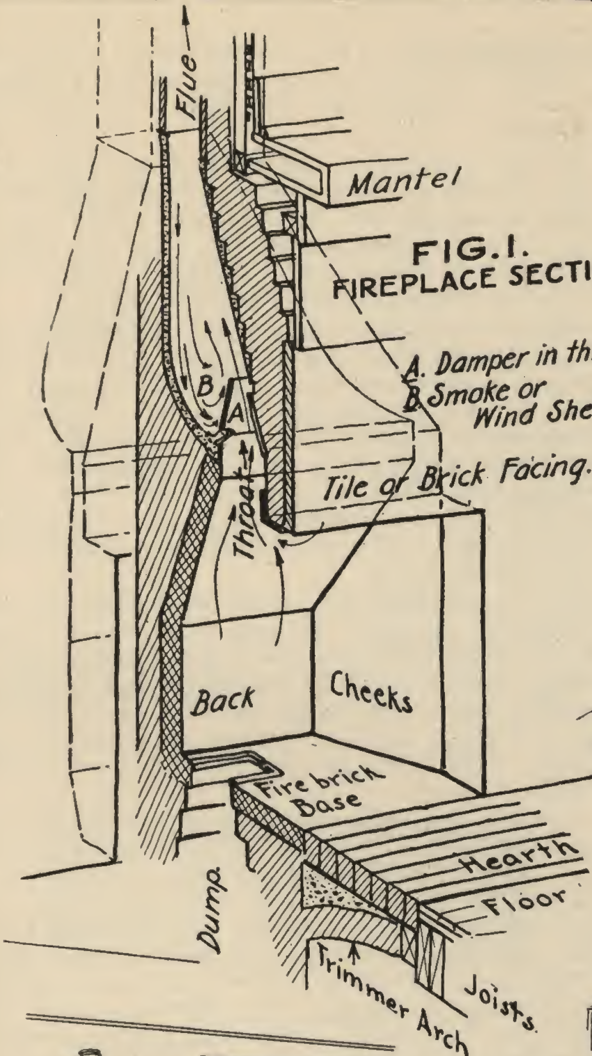


FIG. 2. CHIMNEY FORM

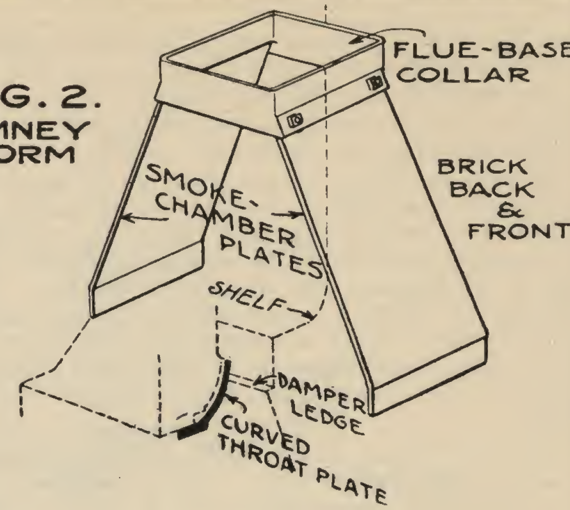
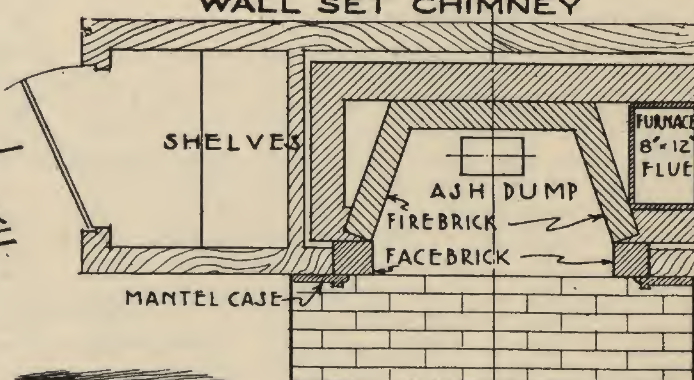


FIG. 3. WALL SET CHIMNEY



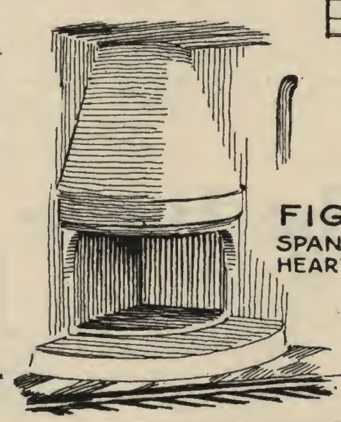


FIG. 5. SPANISH HEARTH.

REMEMBER TO HAVE CHIMNEY CAP 2 FEET ABOVE HIGH RIDGE, & TO KEEP FLUE STRAIGHT. HAVE PLENTY OF SMOKE SHELF BACK OF LONG & NARROW THROAT. HAVE FLUE SECTION 1/10 FIRE PLACE OPENING OR MORE. USE A DAMPER. AND BE SURE THAT ALL OF FLUE IS CLEAR OF THE LEAST OBSTRUCTION.

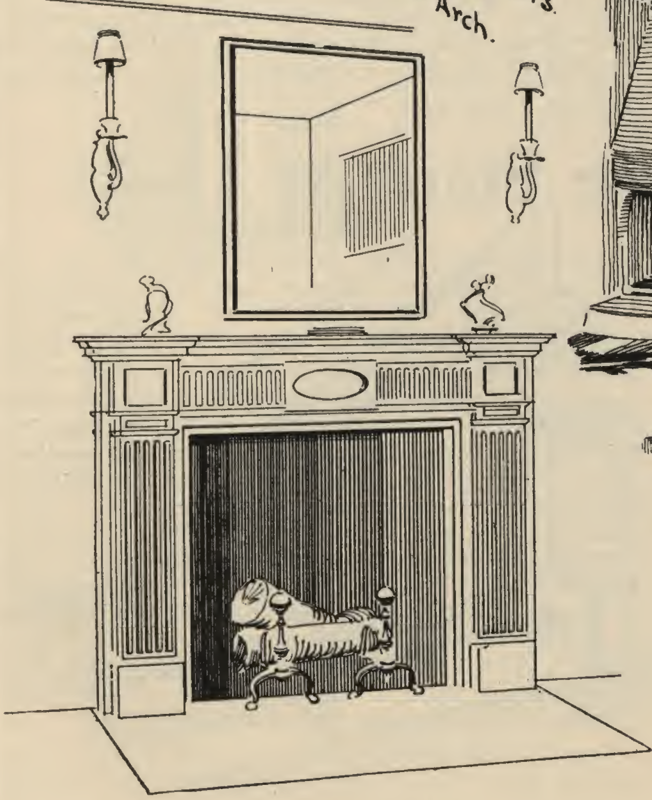


FIG. 4. THE FORMAL MANTELPIECE.

FIG. 6. THE DOMESTIC FIREPLACE

9-5-25

Fireplace Details

into the room and make things uncomfortable. It is to be regretted that such things happen only too often when they should not happen at all. The arrows in Fig. 1 (page 15) show why a damper and smoke shelf are such important points.

Proportions have a great deal to do with the success of a fireplace. So far as appearances go, proportions may be settled to the taste, but there is a definite minimum in the ratio between the opening of the fireplace and the size of the flue. The opening should not be more than ten times the flue cross section. Some say twelve to one, but there are so many other elements of obstruction likely to enter in that I should say the ten to one ratio is better.

The cross section of the throat should be as large in area as the flue or larger, and as wide as it can be made. The lines of the draft should not converge before passing the damper. The ratio of hearth depth to breadth is only to be determined in a general way. The shallower the hearth the more certain must good draft be, and the necessity of an offset back of the throat.

If the hearth is shallow the height must be considered, for, if the arch is high, enough unheated air will be taken into the chimney to check the rising current of air. That would mean smoke drifting into the room with every little vagrant breeze across the chimney top. As a matter of fact a gale of wind might cause less trouble since the chimney would take on the qualities of a Pitot tube and pull the wanted heat out of the room below.

Flues should be lined, all of the smoke chamber should be smoothed off with good lining. The flue should not have any kinks or turns. Unlined flues of chimneys, rough flues and poorly built flues are soot collectors. If the chimney is hot enough the soot will burn, and like smouldering roots in timber tracts these soot filled leaks are likely to make a great mess. This is not exaggerating. I have seen it happen a number of times and I am not a member of the fire department. Line the flues, and brick between.

A cold flue should not rest against a warming one. While on the subject of soot collection it might do to add that round chimney pots are not the best to cap a rectangular flue. The soot collects at the base of the cap and will burn in time. This, of course, tends to crack the chimney pot.

Figure 3 is a sketch showing how inside chimneys can be carried into the walls in such a way that the chimney proper does not project into the room. In a small house, or even in a moderately large house, where the ceilings are nine feet or under, the chimney breast often takes up too much room. Its relative size seems to impose on the whole room. For this reason a chimney which does not project into the room will often furnish more opportunity for just proportions.

The brick manufacturers have followed this same thought in one way, realizing that ordinary sizes run too large for interior modules they have gone into the study of brick for fireplaces with surprising results. Most of us play safe now by facing the chimney piece with brick up to the mantel, and in some cases facing the entire chimney piece with brick.

At the beginning it was said that fireplaces are common to all. We have in this country homes of all types. Lately there has been a venture in a new type of fireplace. With the Spanish type of architecture there is no reason why we should not abide the fireplace of the old Moors. This style of fireplace as shown in Fig. 5 goes us one better for openness and unity. Its promotion adds one more type and brings closer to us the old hearths, the real domestic centers. Surely there is much to be gleaned from the California and Florida homes.

The House Stairs

It is one of the privileges of most professions to be able to disagree with one's fellows with impunity. The opportunity offered here is somewhat tempting. Before me is a tabular form of:

Cellar stairs....	7-inch tread	8 -inch riser
Back stairs.....	8-inch tread	7½-inch riser
Front stairs....	9-inch tread	7 -inch riser
Entrance steps..	10-inch tread	6½-inch riser

This form will show that regardless of the riser height treads are put down less than ten inches deep on the theory that the sum of two risers and a tread should equal twenty-three inches. It brings to mind an incident in a shipyards where the designer of a small ship, a trawler, was instructed to replace a ladder hatch with stairs even steeper than those of the cellar variety on the theory that ladders were dangerous. As a matter of fact the feet are more secure on the rungs of a ladder than on shallow treads. Therefore in our humble opinion the last item in the tabulation is the only one to stand.

So far as making allowance for cellar stairs the times are even more against it than formerly. Risers may run from 6 inches to 7¾ inches, but the riser must be an exact factor of the total rise. If there is anything more risky than short treads it is an odd riser. The last rule is only one to bank on.

As the intent of these articles is toward small house design, the next point concerns the open stairs as against the stair case. Open stairs may be taken to mean either the sort shown in Fig. 5, page 17, with railed stair well, or the type open to the ceiling only. There is no question but that the enclosed flights are occasionally attractive, convenient, sometimes cheaper, etc. A steep flight, enclosed and mysterious, and in an old house, may give a certain undefinable touch. An open stair may lead invitingly into a cased stair. And if the stairs are not intended as part of the picture they may be obliterated altogether. As a last excuse we sometimes build stair cases with a door at the first floor to confound burglars. We have left, then, the open stairs.

Constricting visible space in a small house is a serious thing. So is failure to grasp every means to provide an attractive interior. Stairs are now very well made, plans of decoration usually include the stairs as a unit, present-day heating systems

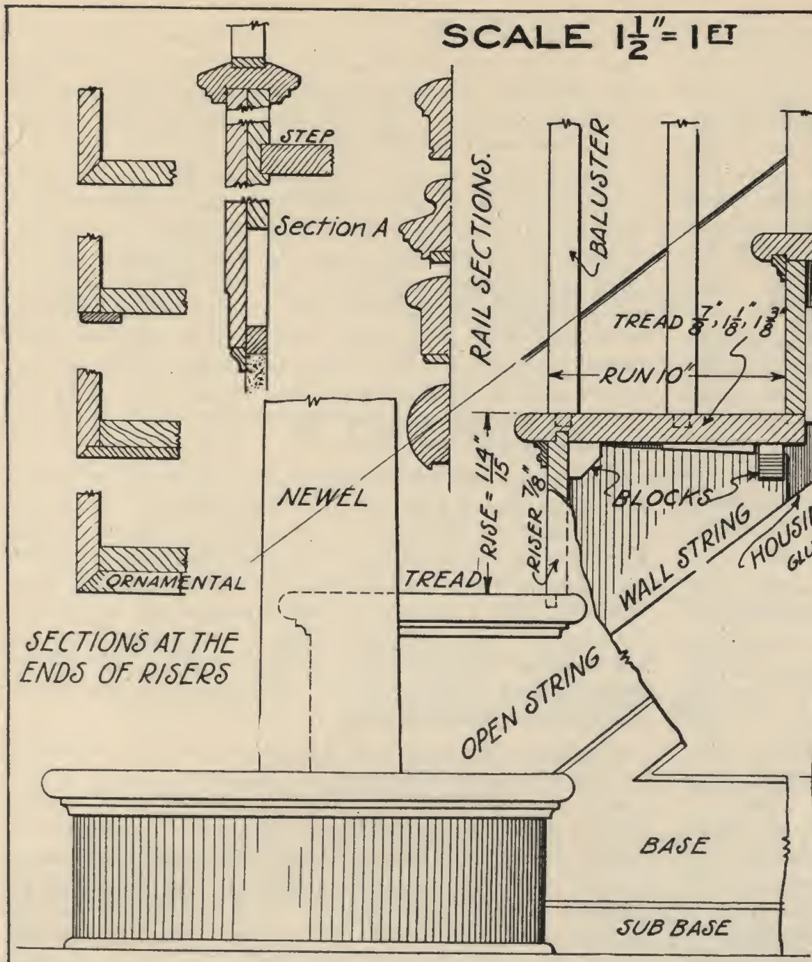
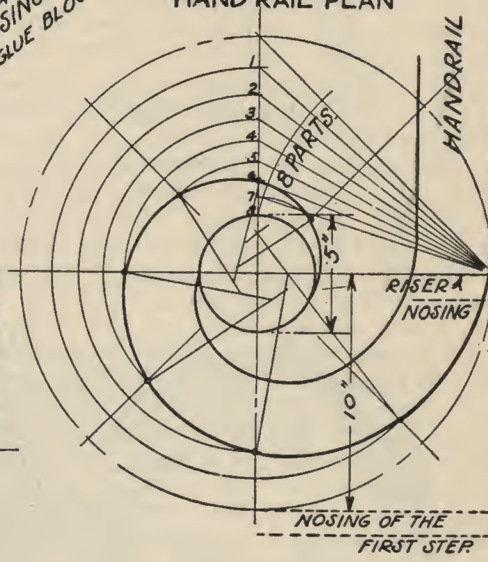


FIG. 1. BROKEN STAIR & DETAILS

FIG. 2.
HAND RAIL PLAN



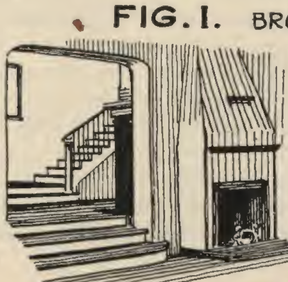


FIG. 3. VARIED FLOOR-LEVELS OFTEN WORK TO ADVANTAGE, ESPECIALLY OVER PARTLY EXCAVATED BASEMENTS AND ON UNEVEN GRADES.

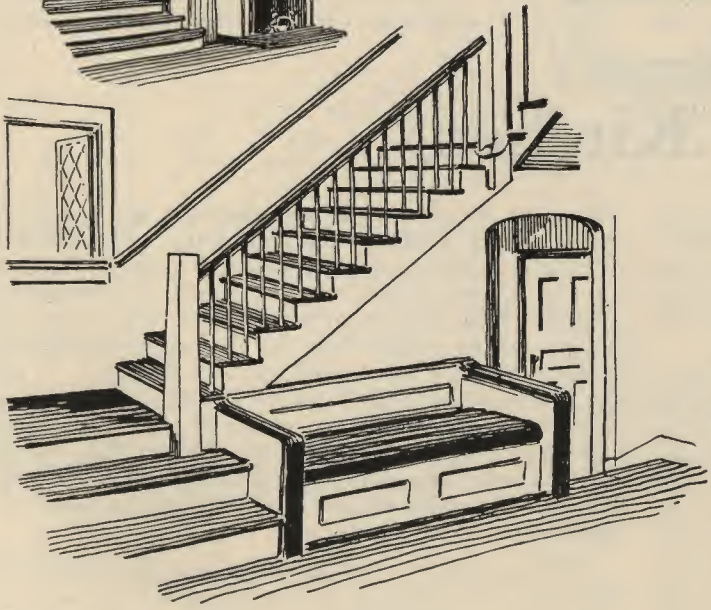


FIG. 4. A WELL LIGHTED "EASY" FLIGHT.

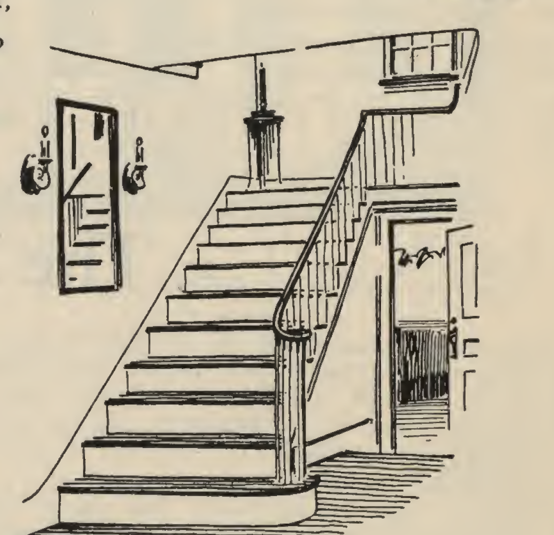


FIG. 5. AN OPEN HALL STAIRS WITH PLENTY OF SUN LIGHT, BUILT OVER AN OUTER BASEMENT STAIRS. MORE SPACE-SAVING THAN WOULD AT FIRST APPEAR. CANDLE-BRACKETS AND MIRROR ARE OBSTRUCTIONS AND SHOULD BE REMOVED.

V. L. Lerman 10-6-25.

Stair Details

give us no excuse for casing them, and they are safer when well lighted. No two-story house should be built so small that a comfortable run cannot be made, and with the lessened ceiling height of the times we have shorter runs. A total rise of 114 inches and a total run of 140 inches, 15 risers and 14 treads, is a sane one if not in a straight flight, and is one that does not come within the old rule. There we come to another point. Straight flights are not comfortable, and they are not safe. One or two turns should go into every flight.

When we take up turns we are concerned with landings and winders. Landings are best, but winders save enough in the total run to give them some advantage. Rules hardly suit here, either, but there is one which seems to stick in my mind. If my memory is correct, this one, laid down by the authorities during the housing period of the war was: "A winder must be at least 10 inches wide, 20 inches from the center." Get three winders in that.

Aside from the question of ease the balance between a landing and winders depends on the chances of making the landing a feature. If that sounds as though the stairs are too important think a minute of some of the best small homes you have seen and recollect the arrangements of the stairs. If the breadth was 3 feet 4 inches or better and the stairs fitted in with what might be termed the motif, then the chance of a spoiled effect was small. There is that chance nevertheless, and one type of stairs comes to mind which should be mentioned but which is too dark to illustrate. This layout comprises three to five risers to a turn, followed by a straight flight. The turn, or landing, is railed or masked or screened and is likely to be placed opposite the front door. Below the rail at the turn and facing the door is a hall seat or bench or locker. This layout makes it necessary to come down the stairs facing a railed turn.

Stairs in small homes ordinarily run 3 feet 4 inches broad inside the rail. This breadth can be carried snugly on two stringers if the treads and risers are housed and wedged, or cut horses can be used and three is the customary number. But the more pieces that go into the structure the more chance for slight errors, the less constant the bearing qualities, the more chance of shrinkage, and the less likelihood of firm, quiet treads. Mill work today on stairs is fully worth its cost.

Surely some builders hesitate on the use of open stairs because of the expense of rail balusters and newels. In one case there was a pretty warm discussion when the drawings showed a simple newel such as is shown in Fig. 4, page 17. When the decorators came to start work one member of the family held him up a long time considering whether that newel, which she saw come to fit the room so exactly, should be enameled the trim ivory or saved for its pretty grain. She agreed presently the grain was not to be considered.

Stairs are not for elaboration. Form or individuality has more to do with their beauty than has fancy work. But there are stairs even in small houses that can readily justify the expense of turned rails and spirals. No doubt they are expensive, considering, but a touch of craftsmanship is to be encouraged. The diagram, Fig. 2, is taken from an old colonial layout for a straight newel. The pitchboard is not shown, but if one considers the spiral he will be considerate of the pitch.

Fig. 3 is only a part of the stair question. Thanks to the growing tendency of fitting a house to its needs and surroundings we can not place the first floor rooms on more than one level without too much censure. Dropping the living room floor from the entrance hall may give more ceiling and a better contact with the garden or lawn. This is merely to indicate that steps are aids in planning some homes and should be considered.

From the practical side we wish to restate that stairs or stair halls are not now as they once were in regard to heating. Heat losses are greatly reduced and more uniform throughout the house, are better regulated, and cold air drafts are becoming negligible. More than one green owner has remarked to me his discovery of a comfortable stair hall. This is due to the great improvements in heating, in insulation of walls and in mill products.

The Kitchen

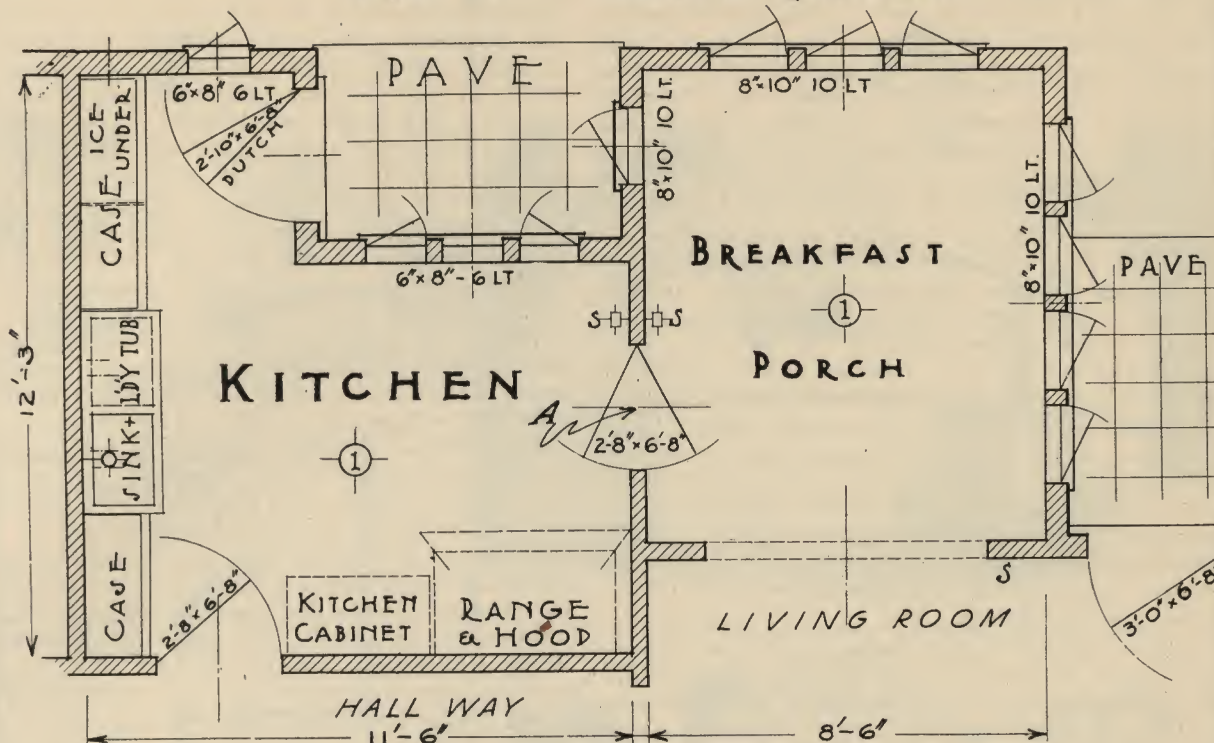
May "a Christmas goose" be our only censure for meddling in the kitchen just before the holidays. Authority may be questioned and our opinions smiled at by those in real authority, but the season at hand is most charitable, and the topic of kitchens in small homes is a live one.

There are two ideal kitchens. The one in which the menfolk may retreat to the fireplace and settle to enjoy the social atmosphere while the women proceed with their never done tasks, and the truly modern kitchen which is so efficiently arranged that the shortened tasks release the housewife from drudgery. Initial credit in the improvement of the kitchen goes to the disgruntled "hired girl" who, in quitting, brought home to the family the fact that the home should be improved. The old kitchen had to go.

Most of us can remember the hustlings out of the way, the admonitions, and the good-natured scoldings as well as the doughnuts. The old kitchen was a wonderful place to the hungry boy but an awful loss of time and comfort to the grown people. Now things are changed. The youngest fellow in the family sits at the corner cupboard cutting out his baby cookies, and shouts: "Take the hint and run, child, run, or I can't get no cookin' done." No hired help, no waste of time, no intense heat, no drudgery. Who is to blame? We should say that the experienced housewives have led the builders and the manufacturers to the greatest improvements of the home.

This argument is going to center on real houses, and, personal opinions and expenses being taken for granted, we will begin thus. In the new house the dining room, as such, was to be omitted. I was for enlarging the kitchen and placing a great fireplace

FIG. 1. SCALE 1/4 IN. = 1 FT.



AN EASY COMMISSARY.

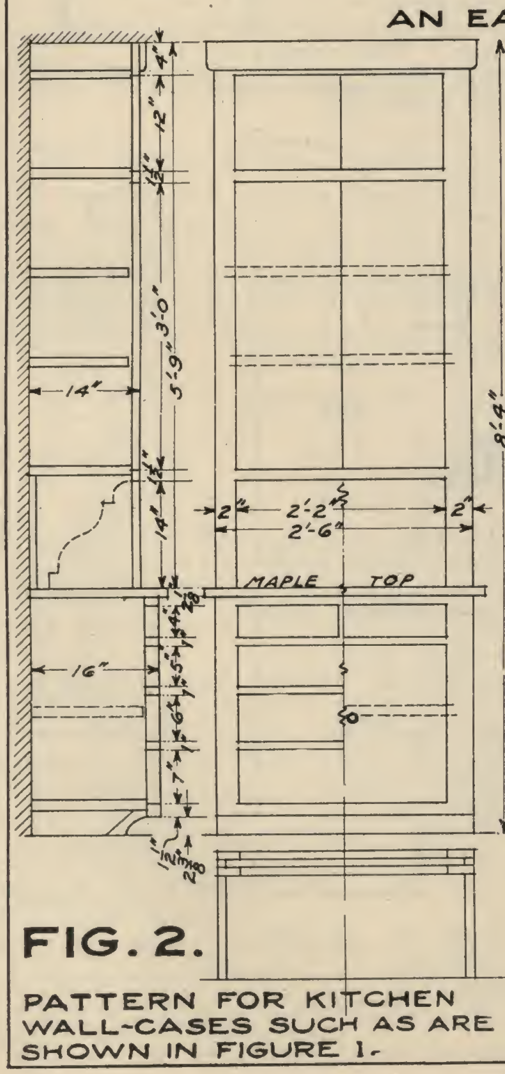


FIG. 2.

PATTERN FOR KITCHEN WALL-CASES SUCH AS ARE SHOWN IN FIGURE 1.

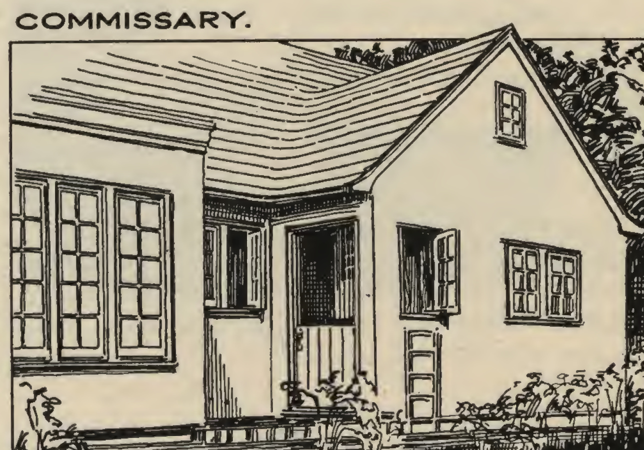


FIG. 3.

THE KITCHEN-DOOR OF FIG. 1.

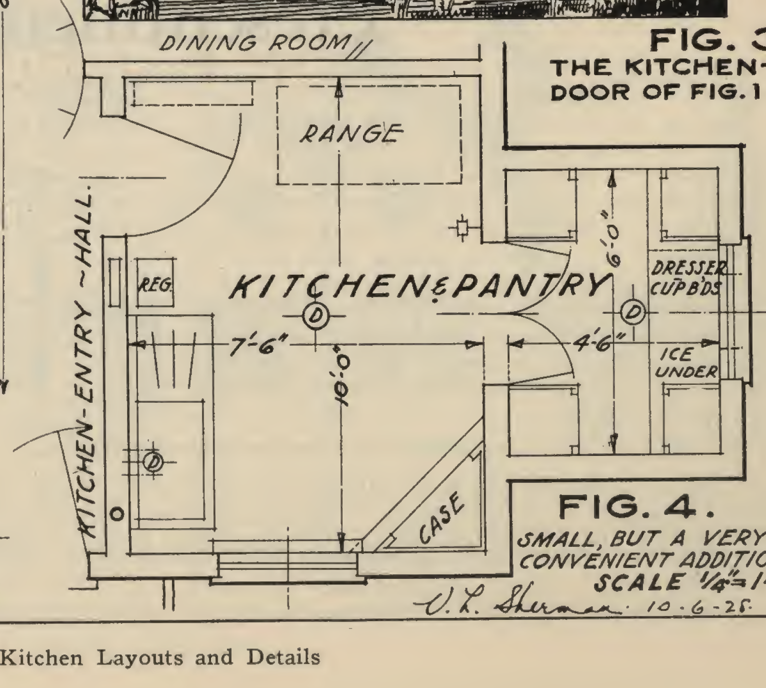


FIG. 4.

SMALL, BUT A VERY CONVENIENT ADDITION.
SCALE 1/4" = 1 FT.

V. L. Sherman. 10-6-25.

at one end with the time honored high-backed benches on a flag-stone floor. That was vetoed as being entirely too mussy for a food-factory. The fireplace was relegated to the attic if I "must have a private one." The breakfast nook was broached next, but I objected in turn on the grounds that there was little space to dodge when the elbows of the youngsters began to play about the table. So the arrangement was made as shown in Fig. 1, page 19.

The favorable points to be recited are not original altogether, but they will show the trend toward simplifying kitchen management. This kitchen faces the street, with a Dutch-door giving an unobstructed view of the sidewalk 50 feet away. A Dutch door serves as a counter against peddlers and the like besides bringing in the out of doors.

The kitchen cabinet and the range with a large ventilating hood are back against the inner wall and near the door. The sink and wall-cases line the further wall. At their counters the ingredients are prepared for work at the kitchen cabinet, sort of routing the production. The window space is left for later consideration, perhaps to furnish the artistic side of the kitchen.

A door marked A caused some argument. Viewing it from the breakfast porch the door should have been reversed, and so it should for its chance of pulling odors from the range. But it is steps that count, and who wants to walk around a door continually. The switches, however, should be on the open side of the door.

Now here is a point that demands some argument. According to all pertinent advertisements the proper place for a sink is below a window. But there seems to be objections. It is said that the light is frequently too strong, and that in cold weather there is some chill. Then there is the vent in an outside wall or exposed pipe. Still a bright sink has distinct advantages, and with practice even a man can do the dishes by touch while gazing out of the windows.

The kitchen cabinet, and the built-in cases are wonders. I know of one coffin-like arrangement running from floor to ceiling that is so helpful to the housewife that she scolds me for criticizing its shape. These kitchen cupboards of modern times are deservedly popular. Everything is at hand, and the cook sits down to her work. It means added time, a pleasanter task, better results, and the average man is better fed for it. When building there should be no effort spared on the kitchen.

The kitchen and pantry shown in Fig. 4, page 19, are the result of a small addition. A window of this kitchen was replaced by a pair of glazed doors which then opened into a "salad making" pantry. The pantry really became a part of the kitchen, but a pantry which could be closed off. The two narrow doors did the trick, saving a great deal of floor space and a great amount of light. The designer of this kitchen had a penchant for mixing salads, but she found, too, that the added floorspace made a neater and roomier kitchen, and that, with its lack of doors, the whole became an exclusive workshop.

Probably the most important points in kitchen design are light and ventilation. The favored kitchen location is toward the north, and with that condition strict attention must be paid to the window lights. Windows should then be given as much consideration as cupboards. If a ventilating hood is not placed above the range the windows or doors should be provided with transoms. Whenever possible a pantry should be situated between the kitchen and the living rooms with two doors to prevent direct openings. This, though, is very often out of the question, which again calls attention to the need of proper ventilation.

There is good reason, especially in a small house, for placing the kitchen on the street side. Many steps are saved through such an arrangement, the outlook is more likely to be pleasant (and more interesting), and back steps are avoided. Such a plan chimes in with the idea that the rear of the house should be the out of door side, and kitchens, especially in a bungalow, should be as nearly as possible the center of operations.

Presentments

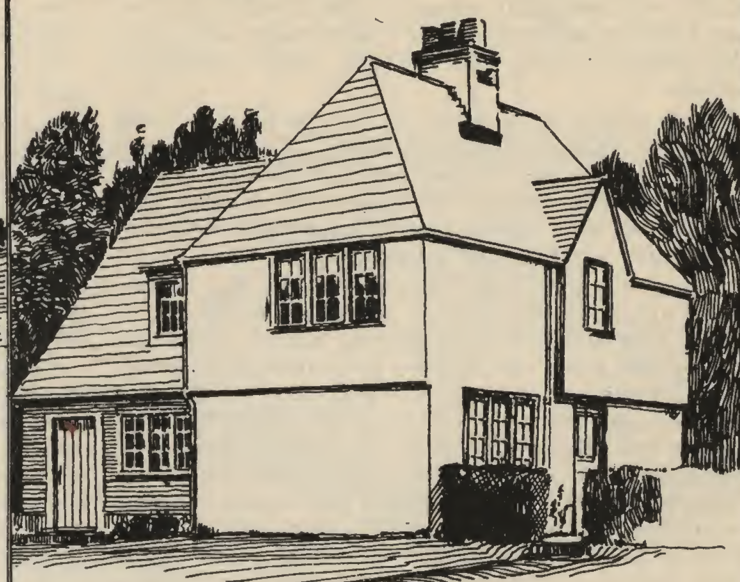
The topic "presentments" is possibly a shadowy one, having to do with the lights and shadows, lines and bulks that go to make up the "home." To do any justice to the subject and allot it its value, is a very difficult job. So much is said and written about art and its relation to architecture that it has become largely a question of suiting one's self. Results then are governed by common sense if art is not striven for, and also if it is. Exclusion of patterns, styles, fads, is in our humble opinion the first step to real craft in building. Bacon reminds us to build for utility rather than for appearance. Sound advice.

In this connection it might do to note that many tell us that interference with the architect's work is generally fatal to the successful outcome. And to this we reply that the owner has no greater friend than the good architect. He it is that hauls the ship close to the wind without spilling from the sails. He is concerned as heavily as the owner in bringing all the ideas under one roof. The percentage of homelike houses is to his credit, and to the everlasting credit of the builders who have the perception. Good builders and architects are the navigators who can take the sights.

"Beware of patterns, because their incessant appeal is like drops of water falling on the flesh. And remember that plain spaces of quiet color are restful; they resemble silence, while pattern, pattern, everywhere is like loud and incessant talking." To get to the point take Fig. 1. This place is, you might say, all roof. But its form, prescribed by the climate and the surroundings, relates it to many sturdy ancestors. It wouldn't look well in a crowd, however.

We are on the subject of roofs, and it was just noted that climate has an effect on the lines of a house. Though colder lands and steeper roofs are associated what can we say for the roof that is so steep that the least thaw will bury the passerby

FIG. 2. THE HIPPED BLOCK WITH BLANKED WALLS



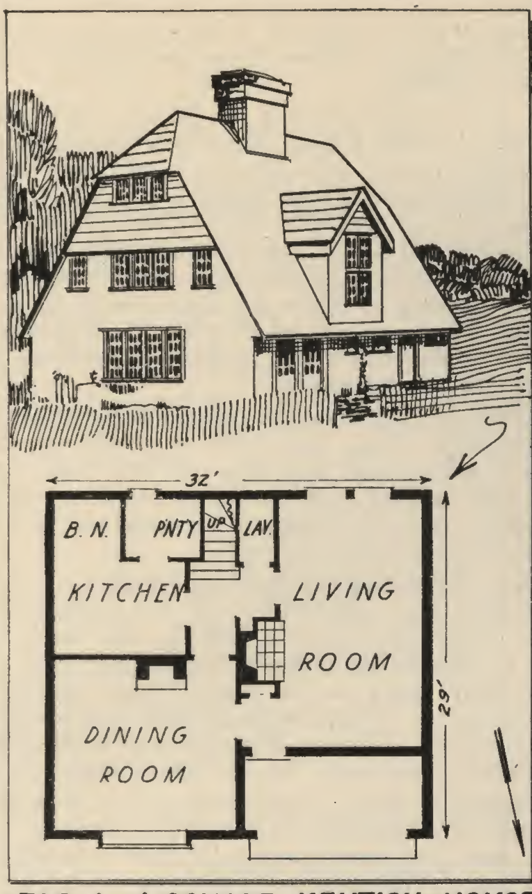


FIG. 1. A SQUARE KENTISH HOUSE.

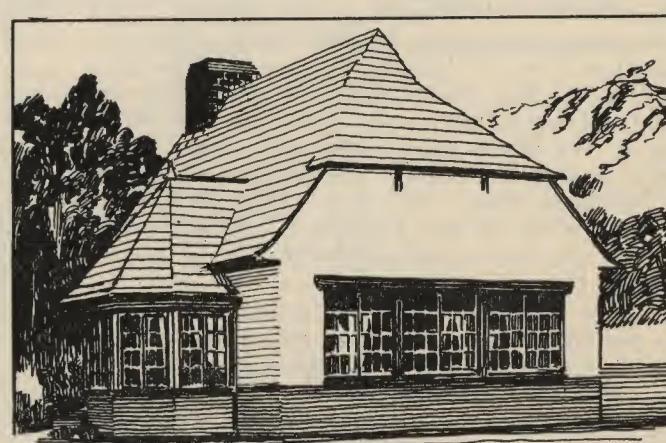
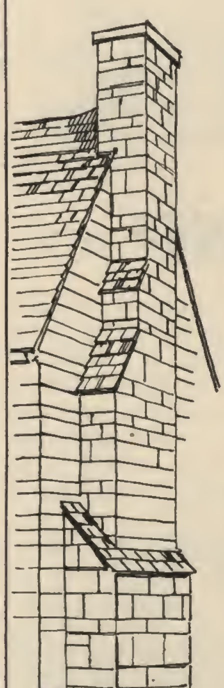


FIG. 3. ROOF AND WALL TO SET OFF WINDOWS AND BAY.



SECOND FLOOR

FIRST FLOOR

FIG. 5.-EVEN IN FORTIFYING MASONRY INTERESTING LINES ARE DEVELOPED.

FIG. 4. A DUPLEX WITHOUT ANY APOLOGIES AND OF HOMELY APPEARANCE, BUT WHY DOES THE STUCCO ABOVE THE SIDING LOOK SO "MIXED"?

V L Sherman — 12-6-25.

under an avalanche. And how about the Swiss? Roofs are traditional, except in this country, but we can find the angle of repose individually with a little common sense, and not too much sawing of rafters.

Some object strenuously to the partition of roof spaces by sharply denoted valleys. There is some reason for this, but to overcome it we can fill the valleys; blocks, raised sheathing, and shingles carried across on a radius. It is no new device, and it is quite a merger of roof lines.

There is some little reason, too, in the advice about quiet spaces. Houses are prone to fill themselves with windows at the least excuse, so much so that bed posts can be seen from most any street. To point the opposite notice Fig. 2, page 21. It may seem strange that every room in this house has ample window space. The effect is certainly against it. Yet there is a quiet country air about the place. The added wall space must give one a great chance to stretch and yawn without taking cold. Then there is an absence of half-timbering which some deem essential to this type of straight line English house. Would it really add to the picture?

We will go along with Ruskin a little further on the matter of roof. His implication that we note the roof at the first, that we literally give the house the "up and down," may have something in it. Here is Fig. 3. We have a solid roof, a quiet space below the snub end, but a regular spasm of windows below. No harm done. And why? Because the designer got what he was after in a common sense way. He may have wanted plenty, but he wasn't after more than he wanted.

In Fig. 3 you will notice that a beam is shown above the window group. This indication of support adds a note of weight to the walls and roof above. There is a tendency in some modern building to neglect the walls. With us a wall, especially the frame wall, is light in comparison to the old time structure, yet houses have not changed particularly in form.

It is convenient, perhaps, to place a door close to a corner, to cut a large opening without providing a visible beam, or to project a fireplace into a room. Such contrivances make our modern thin walls so obvious that the best imitations fail dismally. One authority argues truly and at some length on the misuse of wall papers, tapestries, and pictures, seeking to show us that the process of imitating wall hangings which were meant for decorative wall deadeners has resulted in messing up all our indoor perspective.

Boiled down, the art is to make the thing follow its intentions. Take the dinky bay window that was so common not long ago. A bay was, once upon a time, a unit of wall measurement, a section of a house. Now we apply it good naturedly to a fat man.

To "see the things as they are" leaves us clear of hypocrisy but rather put out on appearances. Notice the duplex house in Fig. 4. We took the liberty to invert the material order, not that the stuff wouldn't stick to the house frame, but more out of curiosity. Siding implies frame construction, stucco does not. Absence of timbering on the gable ends implies some more. Looks funny, does it not?

The moral is that in designing structure where appearance is concerned, or art, if you want to put it that way, our needs must be first considered, then desires. When these factors are given their just shares, build a house that will cover the first and as many of the second as you can recognize. If you are not sure of introductions through mutual acquaintance better let the desires go or you may hate to meet them on the street. You can get plenty of art in building out of your needs if you give them half a chance.

The Gambrel Roof and Others

The roof presents the most interesting portion of the house. Once, previously, a page was printed in these articles and the point of emphasis was the cornice. There was hesitation in discussing roofs in general because of two things. The first was a decided prejudice against cut-up roofs for small homes, and the second was a leaning toward mechanics in all roof work.

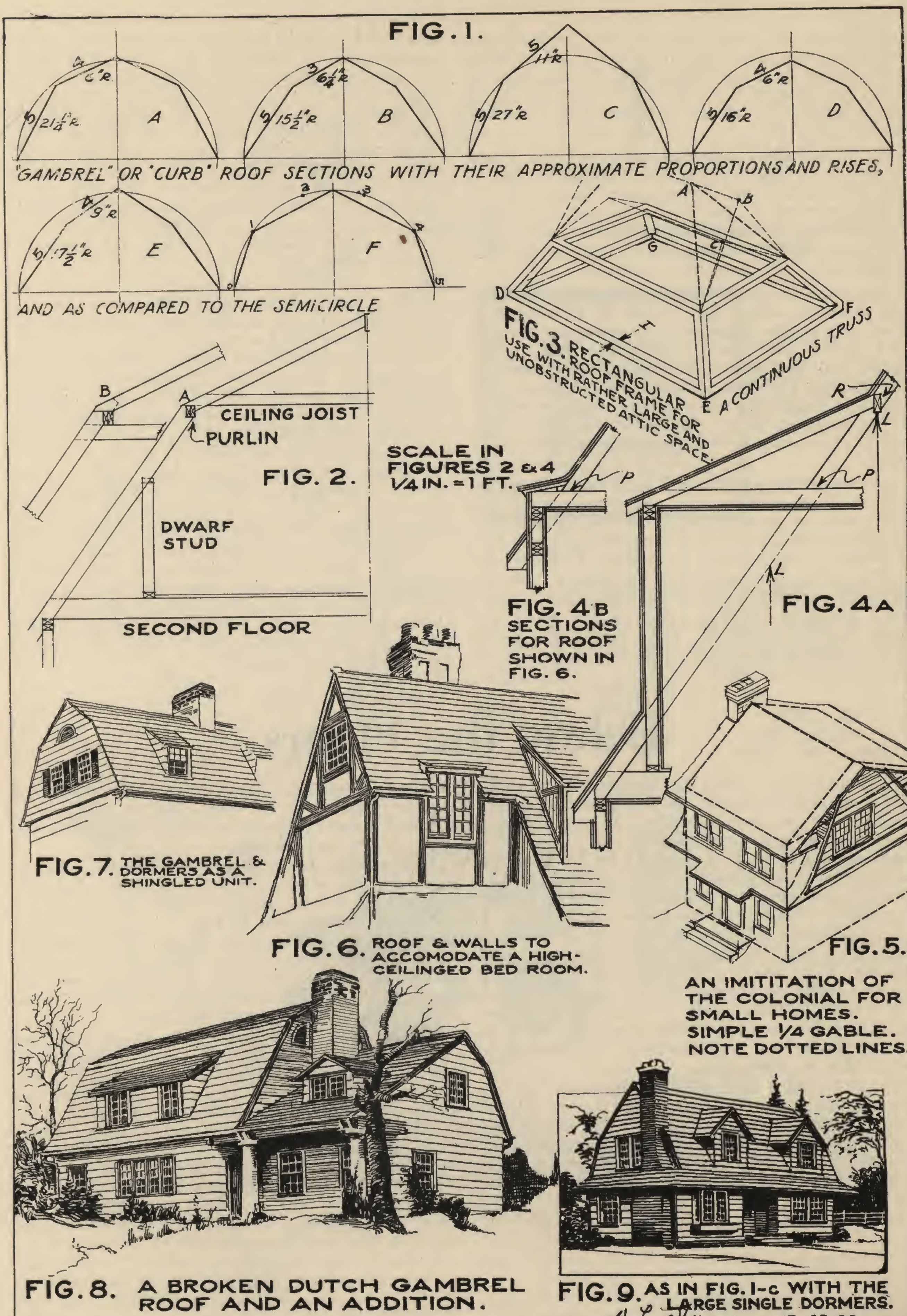
For the first I willingly admit I am prejudiced whenever I come on one of the many pretty houses with even "outlandish" roofs, roofs that are not only a waste of money but a waste of space. There is something fetching about such a roof, perhaps a valid excuse for its existence.

For the second I am ready to admit that stresses and strains as applied to small homes built with standardized timber do not call for a great amount of talk. It is really a question of proper fitting and enough spikes. To get in a last word, however, roof building is a long and interesting study from the mechanic's side.

Taking Fig. 1 you will notice six types of gambrel roof. They are all more or less in use, and the pitches and slope ratios are not confined to these six. Now in times past the gambrel roof was common over the full two-story dwelling, and while we now see it used to exalt the one-story and as brought from the Pennsylvania settlers, we can trace it back to those who built for a roomier attic. To the Dutch it was usually a loft merely. But these reasons for its existence are no bar to use in any way that is fitting.

Shifting the various sections of the gambrel as shown in Fig 1 (opposite) onto the side elevations of a house is an interesting game. There are great differences in their suitabilities. But the last one, Fig. 1-F, is the black sheep of the family. It has pretensions only, and really is an old gage for a Mansard roof. But the thing is used regardless of its antecedents, though it should be impounded.

Fig. 2 is a diagram of framing. At A notice that the ceiling joist is above the purlin, giving more ceiling height than at B where the joist is below the purlin. This is a fair example of the mechanics of the roof as applied to building. Without entering too far into it notice that at A the ceiling



Gambrel Roof Studies

joist ties up the lower side of a low pitched roof and forms this upper roof into a unit load pressing down on the purlin. This weight is supported by the rafters and studs of the lower roof which must take care, too, of applied stresses that are other than vertical.

At B the ceiling joist ties the upper end of the lower rafters much as the truss shown in Fig. 3, page 23, and the low pitched upper rafters have a spreading effect on the purlins as well as a load. For this reason it might do to lay the purlin timbers broad side down since more of the upper roof weight goes into horizontal pressure.

Ordinarily rafters are well enough tied at the base and provided with collar beams so that there is more need to use judgment in considering the roof load on the rafter itself than on the wall. Light rafters will not carry unreasonable load without sagging, and after this has occurred the cut-up roof will show more leaks per year than there are rafters. An excess of work on collar beams and short studs will have to make up for the scanty weight in the rafter.

Of course the pitch of the roof has most to do with the load of the roof on the rafters and of the entire roof on the wall plates, but taking one consideration with another, and considering the amount of publicity that roofing is getting, I should say give it a chance to make good by using a factor of safety of about 25.

Fig. 3 is sufficiently exaggerated to give the impression of a continuous truss that will stay in place and support a decked roof, a hip roof, as shown at A, the old gambrel, as shown at C, or the extended hip, as shown at B. There has always been an association in my mind between this last type of roof and the old thatched roof, thatched in the form of a hip but with just enough left of the gable to air the loft. They are fascinating. What was meant by the figure was to show that regardless of its ability to carry loads within itself or above itself, the whole structure depends on its integrity. If one of the four corners fails, or the plates begin to spread at the sides, as at H, then it will surely disintegrate. Such roofs must be carefully prepared.

Fig. 4 and Fig. 6 are used for one particular reason. Noting how houses fall into classes or types generally, one comes to the conclusion that floor spaces are fitted more into exteriors than walls and roofs are built about rooms. Allowing for the popularity of certain floor arrangements and their typical exteriors we still believe more builders should use the roof of the home, when they need to, to satisfy their best floor plans. There is nothing unusual in the roof and walls of Fig. 6.

Fig. 5 is not so bad in its way, probably about 18 feet by 24 feet, but allowing for volumes, areas, paint, trim, work, etc., a larger house of plainer drawing might have been had for the same money.

Gambrel roofs will associate with roofs of other types. In Figs. 8 and 9 you may see two gambrels of entirely different sorts, both with the presumed attic floor in full use, with plenty of dormers, both over single story walls, and neither very badly hurt. Charm in a roof lies more in its apparent capacity for covering requirements.

Below the Floors

After prating so much on appearances it seems that something had better be said about the understructure. I once told a builder who was skeptical of in-swinging casements that my fear of them was slight since I knew that when he built for me the house would be sufficiently well built all of the way up from the footings to provide against poor fittings in casement windows as the house wore.

A good house starts in the ground and not just above the grade. At the top of the opposite page is Fig. 1A, B, C, and D. Starting with Fig. 1A we have a box sill, sometimes called the western type. When the foundation wall or block wall is carried up to the plate and above the ground we have, in a frame house, two wall materials. If the wall is stucco then we have one.

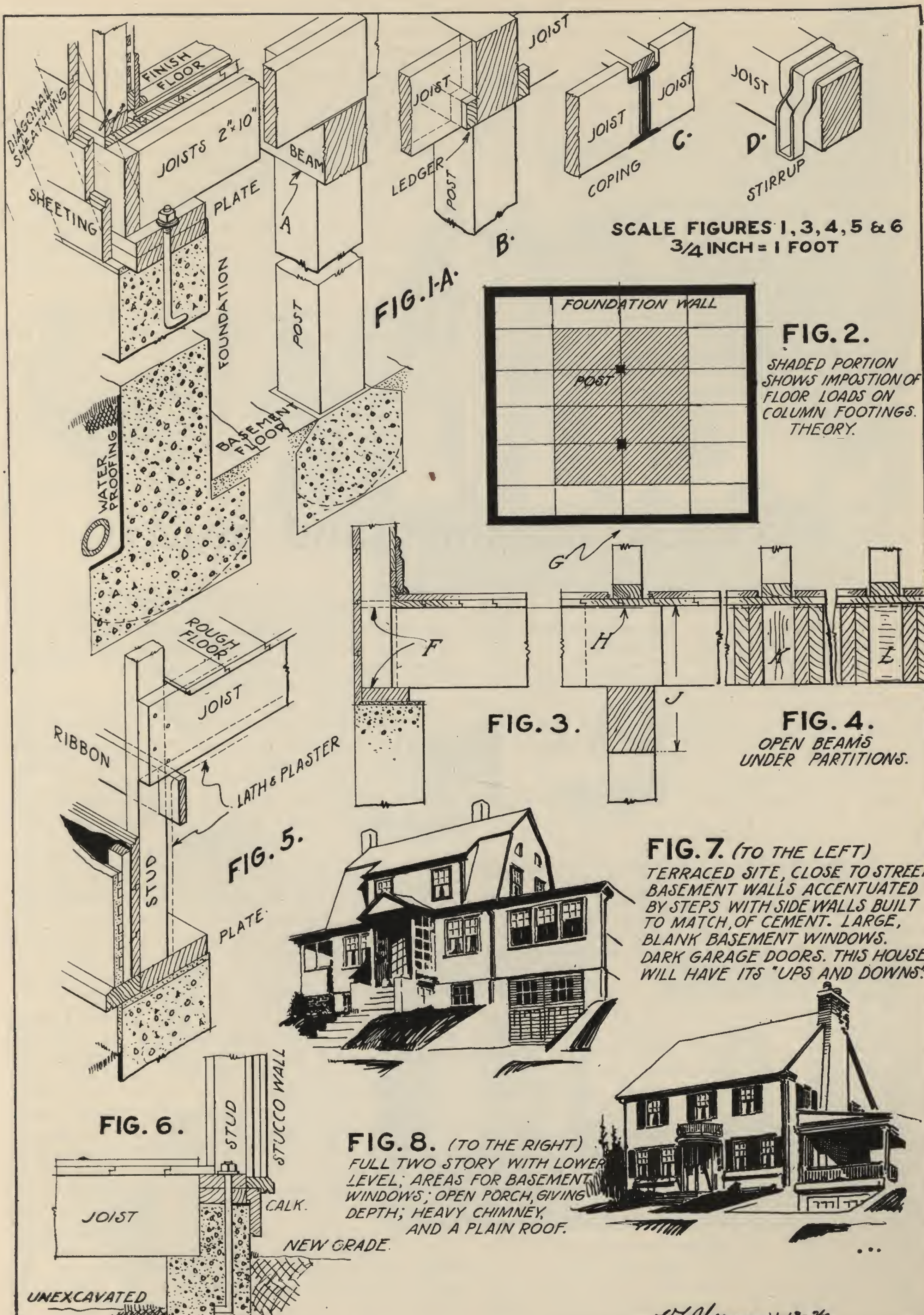
This difference in appearance from the outside should have some bearing on the use of sills as shown in Figs. 1 and 5. The basement of the first is generally warmer, especially if the joists are filled over the plate. And in Fig. 1 we have a natural fire-stop below the wall and a better start for framing.

In a two-story house where the wall weight per square foot on the foundation is fairly heavy and the sheathing is horizontal no anchor bolts will increase holding strength. They will, however, increase the binding qualities of the plate and insure against slips. Where the sheathing is placed diagonally, and each piece gets a grip on the plate, there is reason enough for the bolts. In one-story houses the wall weight per foot of plate is much less and there should be anchorage.

Now as regards shrinkage. One of the commonest of troubles is occasioned by settling and shrinkage. What it does to the partitions and trim is amazing. If the joists in Fig. 1 are leveled when they are laid and no account taken of the shrinkage, you will find that settling of the post on its pier, settling a trifle of the beam on the post, and the increased depth of shrinkage in the beam may work havoc with the plaster and trim later.

Taking Fig. 2 as a theoretical sample you may see that footings for the posts are of first importance. In Fig. 1B the beam shrinkage parallels the joint but rises the plate. There is a question whether the added head room as shown possible in these smaller figures compensates for the chances otherwise. And along with this should come the great importance of footings. The underside of the footings should never be anything but flat. The kind shown in dotted lines are used no doubt on some cheap work but should be carefully avoided as most anything can happen to a footing of such character.

In Fig. 3 where the studs are carried on the plate some provision must be made for a fire stop between the basement and the outer walls. Grouting, extending the sub-floor and plastering fulfill this. The



Details of Foundation and Floor Construction

first and third insure a warm basement. Without these there is danger and a good deal of radiation of heat leading to cold floors. Again shrinkage. At times it is required to run open beams below partitions as shown in Fig. 4, page 25. This makes them more accessible for risers. Then bridging such a beam the grain of the wood should run with that in the joist as shown at L, and not perpendicular to it as at K.

The construction as shown in Fig. 5 is very common and while it does not give as good a framing base as the one shown above it, it will do very well if too much wall weight is not carried on the studs below the first ribbon. And if the wall is thoroughly insulated. And if there is a sure fire-stop. This type is one in which more chance is taken on radiation of heat and soundness of floors, but there are a number of advantages. Care should be taken to keep the plate far enough above the grade to prevent dampness with its consequences.

Fig 6. is to show the foundation wall construction for a basementless house. If the house is kept warm the floors will be warm. Here the plate is leveled, bolted and calked, after framing. The floor joists rest on a shoulder and are clear of the grade by enough to allow a cold air duct to travel under them or for pipes. Some means of ventilation should also be provided from inside. So long as foundation walls are being discussed suppose we consider Figs. 7 and 8. These two houses show that some consideration must be given the height of the basement wall above the grade because the house itself may not be placed promiscuously on foundation or site. Nearly every part of this house tilts the head back even while we know instinctively that such a house is designed to avoid unnecessary height.

Fig. 8 gives a full two-story height but with some compensations. However, we wish to say this about basement garages. They are not wholesome things when you are in that basement. The best thing to do whenever the engine of an automobile is running is to get out from under, or to provide great open space below it. This accounts for the little bridges you see at the repair stations.

Concrete Masonry and Stucco

One of the blessings to which we, in this country, are heirs is reasonable diversity in building materials. Because of the wide geographical latitudes and the differences in climates we are able to check the best methods and materials over the whole range. None of these methods or elements should escape the architect or builder who has an interest beyond his collections and they should not escape the prospective client. By the signs of the times they do not.

It is not to be supposed that every village in the country is to support a collection of conglomerate types of houses, or that what is good in one locality is necessarily good in another. The gist of it is that we have a much wider range from which to choose, and less tacit objection to the more or less new type of building. To concentrate on one point for decision in choice of building materials take simply freight rates. The question of transportation facilities can bring more saneness onto the job than anything else.

Perhaps that is the reason for the saying that the best of building materials is any one of them. They are all best. Many, of course, will not agree with this and you can put them down as biased, reasonably so, for no contractor or architect worth while but has his favorite methods and materials. If he didn't have them his finances would show it.

One of my friends has the brick veneer habit and what a complete job he can make of it! There is positively nothing finer. Another would not have a veneered wall on a bet but sticks to "concrete masonry." They are both absolutely right and with others of such set purposes are obliging the building industry by helping to refine their own particular branch. Do you get the drift?

So in starting these sketches of the various elements of structure we propose that for every house there are suitable materials which will bring advantages to the building and its appearance. And we also propose that in nearly every locality there are conditions and limits which are well to be observed if the house is to be built with economy. These limits are not always freight rates although freight rates are often the limit.

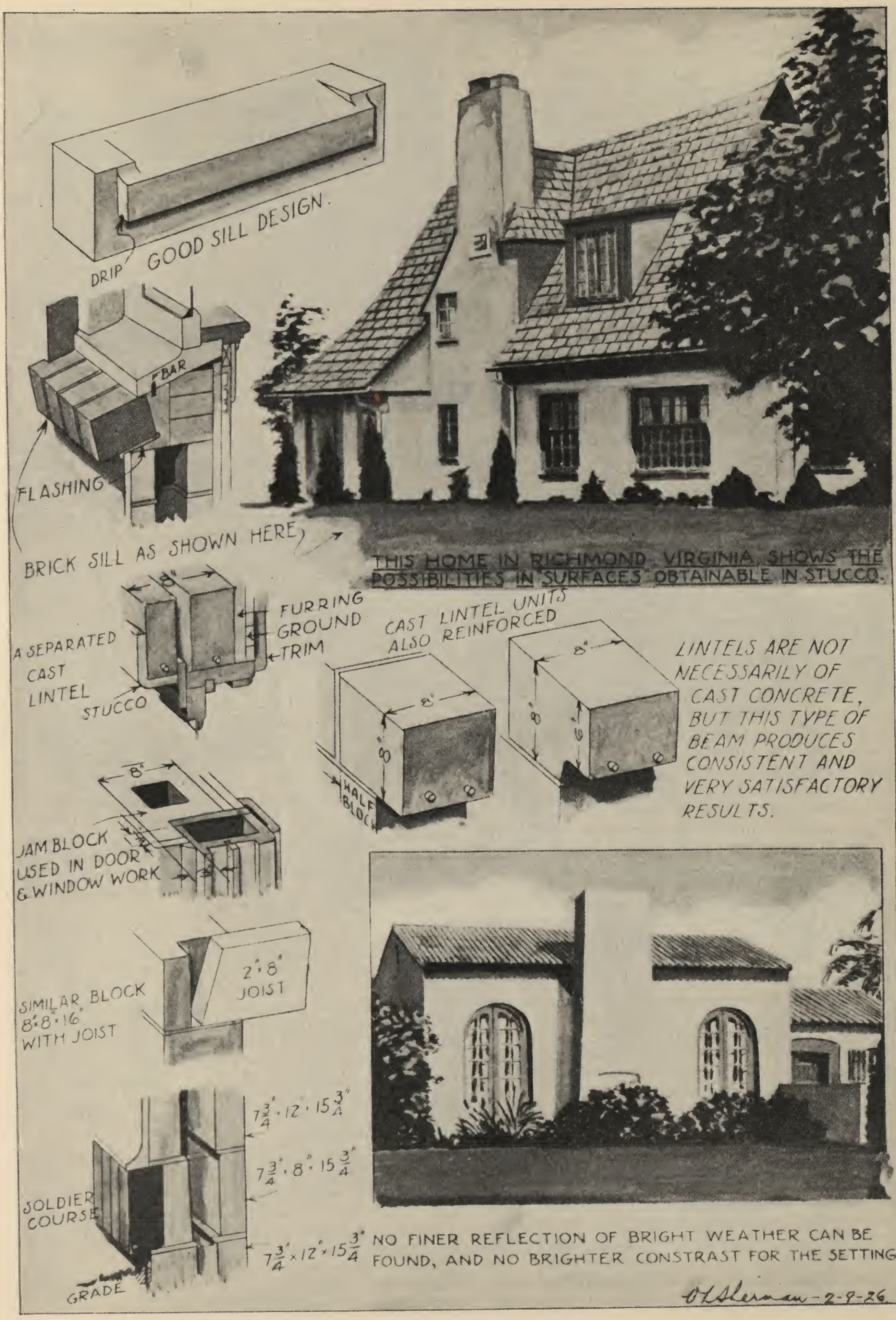
Years ago we used to speak of "cement block" houses and were told to observe their dampness and ugliness. But times have changed. Only the other day I had to be pardoned for mentioning a cement-block house. The term is not only passé but supposed to be obsolete and justly so, for there is scant resemblance to the ancient type in the new home built of concrete masonry.

But before going any further, the question of dampness ought to be put plainly. Dampness may have ill effects and on the other hand dryness may have as bad. Chronic cases of either lead to fatal results. But a good deal of so-called dampness is from the condensation of normal atmosphere on relatively chilled surfaces. You will find this anywhere. But it is easily and usually prevented.

Take, for instance, a solid wall of any type of masonry. At times that wall will become cold enough to reach the dew point. But suppose the wall has a furred inner surface, providing an air space for heat insulation or is continuously hollow providing its own insulation. How much more slowly will that temperature be reached on the room wall? In a house of the hollow wall type having its lath and plaster on furring you have really more air cell space than in a frame stucco house which, so far as I know, has never been accused of dampness.

They have taken rock face building blocks away from us because they look like sin and require too much cement stucco to alter their appearance. No matter how they are pointed, they all seem to be going south.

The modern method is scientific, reasonable and



Masonry and Concrete Details

really beautiful in results. Starting from the footing, the wall goes in with precision and known strength, receptive at any point of artistic trim and change of line. Dozens of combinations in construction are readily absorbed by this same block wall and when finished the cement stucco will allow as much latitude in type as one could wish. For example, take the two houses shown. Except for desired wood surfaces they might both be built of concrete masonry from bottom to top.

Most builders know that there are blocks sufficient in form to provide for every emergency and to these the sketches to the left of the page are familiar. But the art of concrete is stepping along. All of the effort of the industry goes for improvement and past effort now enables the building of the soundest of houses with a wide choice of architecture.

Not all walls are furred on the inside. If proper air cell space is embodied in the wall and the outer surface is waterproofed there is no great reason for it. Then it becomes a question of grounds and this may be taken care of in a number of ways.

The outer surface is what seems to be most intriguing at the present. Texture and color seem to run riot. There seems to be a texture for every race and a race for every texture. I have seen so many different textures so well adapted that it is impossible to specify. So we can say withal that concrete masonry is of the best.

Values in Siding

A white village set against a background of northern pine first set me to conjuring years ago. The community was northern, and Scandinavian, and when I came on it it was all of sixty years old. Since then there have been repeated instances impressing the sturdy character of such building with all the graces which go to make up homes. It strikes me as particularly reasonable that northern folk should go into the timber for their material, but as in my case most of us forget that the timber furnishes as fine material as any could wish when the requirements are staunchness as well as style.

There is life to wood. There is a realness about it that is reflected in every man who appreciates it. When we are all gone and forgotten these frame homes will be in their ripe beauty. When a rich man dreams of a cruise it is in a shiny sloop, and he can name the different woods that go into her from the truck down. He could scarcely do better when he dreams of a new home, and if he would apply himself his ambitions would be set.

To go back. These early homes of frame, and, in fact, all homes in more remote localities were often built with a minimum amount of what we now use from the mill. Time and labor brought the actual cost relatively far above what it is today. The men who built these homes were most familiar with timber and followed it through from the axe to the last hand made shingle.

To get desired effects they must have deliberated on proportions in measurement more than on how much trim the house would stand. Economy meant plain surfaces and corners meant more joining. But their compromises brought success to the whole except where the work was heartlessly done. Wood for surface will stand a great deal of abuse in the way of coloring and cutting up, but when a home is to be frame give the wood a chance to show its warmth and pleasing appearance.

The well proportioned house with wall and roof in sympathy can be brought out by no better means than the shadow lines of the siding. These should not show like the circular stripes in a red stocking, nor should they be so broken up as to lose their purpose. They are part of the picture.

Frame houses, too, have the advantage of homogeneous structure. Perhaps because of that as well as anything else can we term such a house one of character. With the wall plates on the real builders are the carpenters, and no craftsman may be prouder of his work when he can top it off with well placed trim and nicely hung doors and windows all ready for the painter. The workman is on the job practically to the end.

The structure of a frame house is not essential here. But since permanence of structure is always to the point some notice should be given to points occasionally passed over. Lighter timbers have replaced heavy beams, much of the fitting is done before the material comes on the job. Responsibilities in general are less to individuals and poor results more likely to follow. The first essential in the construction of a frame house, it seems to me, is fire prevention or, rather, protection. The construction which used to be more solid in weight has opened up in places.

In Fig. 1 is shown a spacing of four inches from the chimney to the stud. That space is protection against burning soot in mortar crevices. The spacing at the side assures like protection along with the added clearance in case of settling. Flues should by all means be lined if for no other reason than reducing the fire hazard.

In Fig. 2 is shown a fire stop of incombustible material which should back the trimmer. And to close the joint a metal strap at the edge of the lath and plaster. There is one sure way to prevent the spread of flames in or out of a firepot. Stop the draft. Close all openings that might allow flames to communicate. Partitions, outer walls over sills, around pipes, especially around chimneys. Don't be afraid to be foolish about it. Along with this fire stopping from the inside, we wish to say that fireproofing the roof will certainly not curtail efforts toward beautifying.

Another of the items in frame construction sometimes overlooked is proper bracing. This applies to every part of the structure and as an instance we take again Fig. 1. In closing the corner between trimmer and header we might overlook a few inches or even brace against the chimney. But a cantilever box will escape either and provide support of that small area. Like well built cross bridging, these little levers throughout the house mean a lot. It is

WHITE SURFACES OF PLAIN DWELLINGS FORM A REALLY DELIGHTFUL FEATURE.

BROAD SIDING SHOWS WELL ABOVE STONE.

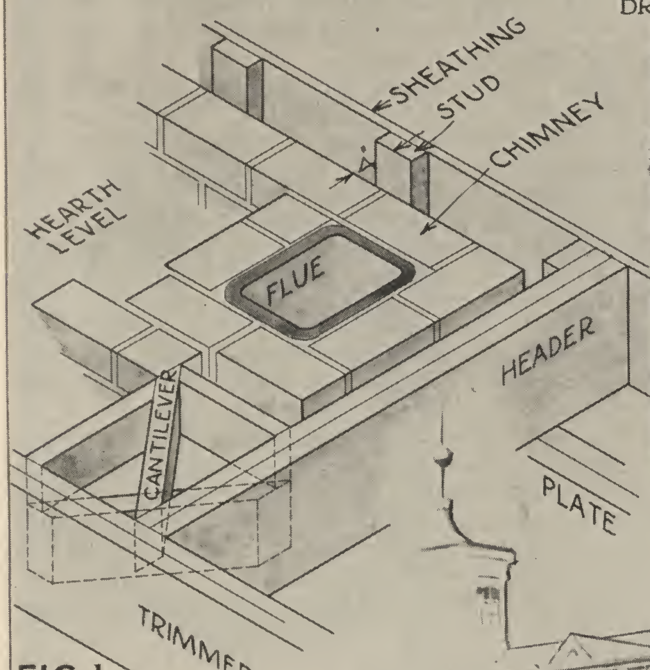


FIG. 1. CANTILEVER-BOX AT HEADER CORNER OF HEARTH.

SIDING IN PARTICULAR SHOWS THE BEAUTY OF REAL OR APPARENT WEATHER-WEAR.

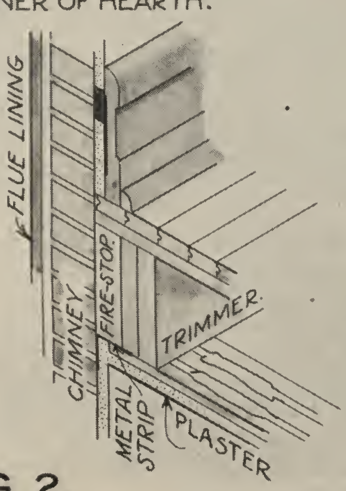


FIG. 2. FIRE STOPPING BACK OF TRIMMER.

FORMALITY OF LINE AND THE GRACE OF THE CLASSIC ARE SHOWN IN AMERICA'S OLDEST HOMES.

V. L. Sherman 4-4-26.

Good Practice Using Siding

the same difference found between ill-fitted joints full of nails and snug joints with a few.

There is no building material that will adapt itself better than good siding. I have known many houses, especially country homes, wherein stone and frame was combined in comfortable unity, sort of a natural bond. In the drawing it may be noticed that the same stone was carried from a heavy chimney out far enough to finish off a single wall. This may have been intentional but might have been expedient.

There is also that quality in good siding when properly handled and stained to attain a weather worn air that is very like the lichened stone in its element. Such a house appears to be of the aristocracy if it looks well or a vagrant if it doesn't. A chance is taken when such an aim is taken. Take care to use the proper material for siding and as reliable a roofing. They've got to get gray together.

In making the last sketch of Mount Vernon, I was warned that the "cellar-door" ought to be explained. But that is unnecessary. The point is that whether a home be formal or cozy siding will take its place. The lines in the first type are given the lightness they should have, and a freshness without the effect of newness.

Stuccoed Walls

Conceit may not commonly be called a virtue, yet there is that quality about conceit, or self-confidence if you would, which, when backed by study takes on something akin to virtue. It is the power to conceive. Now this is primary in my mind to the use of stucco. Stuccoed walls are unlimited in their possibilities for picture making, and their best use lies in presenting form and color. Therefore if your home is to display either or both, lay on the stucco with a strong hand and a strong opinion of the outcome. Do not compromise.

In Figs. 1 and 2 on the opposite page there is an attempt to show what this may mean. In Fig. 1 the flat angles and deep shadows are accentuated by the light blank walls. Colors will show brighter against these contrasts especially in the roof. While there is a great deal of contrast in the picture it may be noted that there are no sharp edges except the shadow lines which, being unreal, tend to soften the contours of the building. Stucco, of course, is the ideal medium for such a scheme.

In Fig. 2 there is what might jokingly be called geometry. Such arrangement of surface forms with resulting light and shadow brings out a design in the perspective rather new in this country. It is still in the experimental stage, and I sincerely hope that most of it stays there.

But without encroaching too much on the house as a home there are aims in the direction of form which are creditable. In this particular case the fairly blank wall with grouped windows, the upper story windows being a trifle high, the high pitched roof and the dark louver at the peak, one is surely pitched on the gable.

For those who have strong likes or dislikes, and who are opinionated enough to lay on with an unalterable hand, and who have something to show in the building line, I should say there is no better medium for their expression than stucco. Small or big, the house can have attraction, which is what conceit wants most.

In Fig. 3 there is an attempt to show a very pleasing phase in stucco. This rather solid half-timbered house with its moderate tones and sombre lines might be of any of a number of different constructions. The plain stucco wall is not meant to hide the construction in the least but the effect of solidity is there. Now note that the apparent heaviness of the whole outline, and especially the roof, is cheered up by the window groups. There is merely stuccoed surface between the units, hence they fall in with one another all the better. Could any wall oblige better than stucco?

Since I have only one page on which to focus the epitomized results of experience perhaps you can stand a few more views on the subject of stucco. Stucco in a sense is very modern, and the methods of building for stuccoed walls and the methods used in casting the walls are almost of this generation. With the present acceleration in improving the handling of stucco the next generation will gain further improvements. There is no doubt that stucco will become increasingly popular. Totally unlike the past generation there can be no excuse for a future one to look back at a cracked edifice and remark: "See this our fathers did for us."

Stucco is going to be increasingly popular, and I could wish to return for a look 100 years hence at the monolithic walls. When these younger builders have adopted the ideas of plain walls, and recognize their freedom of hand with the other elements of their building what won't they do with form and color? Our ideas of approved types of architecture may be given an awful wrench. No doubt as before inferred there will be experiments but, thank heaven, no gingerbread,

Now suppose we consider stucco as one of a group of elements. There is no reason for supposing that stucco must be used alone. The sketch shown in Fig. 5 illustrates a case. The place is small, and shingled walls would likely make it appear a bit smaller. Stucco walls, with a bit of stiffness about the cornice, and a shingled gable make the place bulk larger and give it a little different aspect. There is some room for question in the use of such a combination in its attempt to achieve dignity.

In Fig. 6 stucco is shown used as part of a very solid structure. From either end of the scale in weight stucco will abide its position. Here the stone wall and rolled thatch require a bonding element other than stone which will not show incongruously. Stucco fits. The same might be said of the house in Fig. 4. We can conclude therefore, and with reasonable honesty, that stucco is not a makeshift expedient but rather a free element which can be used singly or which will lend itself in the most generous ways to unite with other walls.

FIG. 1

FIG. 2.

FIG. 1.
PLAIN SURFACES, DEEP SHADOWS, BRIGHT COLOR.
FIG. 2.
SAXON GEOMETRY, SPACES, & ANGLES.
FIG. 3.
TEMPERATE TONES FOR TEMPERATE CLIMATES.
FIG. 4.
AS A HEAVY MEDIUM BETWEEN THE BRICK AND THE HEAVY EAVES.
FIG. 5.
ADAPTS ITSELF WELL TO LIGHTER STRUCTURE.
FIG. 6. IDEAL WALL UNDER A ROLL THATCH.

FIG. 3.

FIG. 4.

FIG. 5.

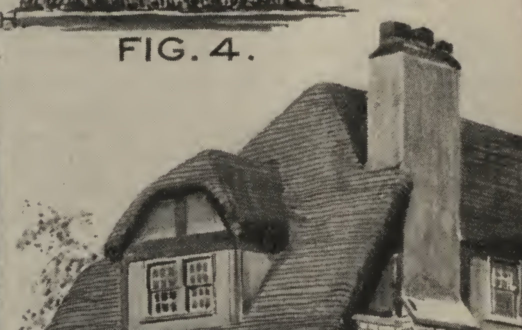


FIG. 6.

O. L. Sherman 5-2-26.

The avoidance herein of structural details is not because "there is nothing more disenchanting to man than to be shown the springs and mechanisms of an art." It is, as Stevenson adds, that "those disclosures which seem fatal to the dignity of art seem so perhaps only in the proportion of our ignorance." If this one page only acts as an appetizer it will lead you to more structural information than I could furnish on 50 pages. The most interesting feature in stucco is the preparation of the base and the application.

Stucco well applied is much more substantial than generally believed. This may sound a trifle absurd but some tornado witnesses will swear by a stuccoed house. However, I have noted that with a reduced wind velocity and with a greatly decreased temperature the two air spaces formed in the walls of a house by stucco, sheathing, and insulated plaster will greatly reduce cold penetration.

As now used stucco should not stain from beneath or absorb stain from below.

Brick Veneer

As regards building it is unfortunate that the word "veneer" has a double sense. While it may mean the covering of a substantial base by a surface of high value, it also means the hiding of a mean base by a gloss. It is unfortunate because brick veneer over frame or, in fact, any fabrication in building involving a dress coat, tile, terra cotta, brick, stucco or what not, is not actually a veneer. And, to digress a little, we might go further and attempt to prove that veneer in wood is everything but bad. We are quarreling with the sense of the word. The origin possibly came through some witless statement such as "in these products each unit contains air spaces which comprise about six-tenths of the total cubic area of the block" or "bungalows and residences."

Brick veneer over frame is of purer fabrication than its name. It is double cell construction of soundness, very nearly fireproof, cheaper than entire brick, and, when judicially used, extremely attractive.

In these articles the aim so far has been toward the less expensive houses and this seems the logical point at which to raise the ante a little. The per cent increase in this type over the cost of frame or of stucco is a question of locality, but generally it is small and sometimes nil if upkeep is regarded.

As to soundness of construction this much can be said and applied to all types. If the work is confined to its intended limits and done in a workmanlike manner it is altogether satisfactory. The frame of the building is completed first, as shown in Fig. 1, and might be finished in frame or stucco, but in brick you will see that an extra foundation sill breadth allows for an air space of from one-half to 1 inch and for a separate brick wall to be tied to the studs as shown in Fig. 2.

Now as to the advisability of running a single-brick wall two stories up. Suppose a stucco house is subjected to a wind velocity of 80 miles per hour or a wall pressure of 30 pounds per square foot. Would you expect it to collapse? Certainly not. Suppose you replace the stucco with brick founded separate of the frame and tied to it with a 20 penny or 30 penny spike for every 1⅓ square feet of wall. (Every five courses, in all studs, at 16 inches on centers.)

Now suppose a 20 penny nail driven 2 inches into sheathing and stud and a hammer hooked to it with the claw up and the handle horizontal. You have something similar to a bell-crank lever with a ratio of about 10 to 1 favoring the handle. How much weight would be required to start the spike? This may give some notion as to the strength of the lateral bracing furnished by the spikes. With conditions fair such a wall has considerable advantage in strength over general framing.

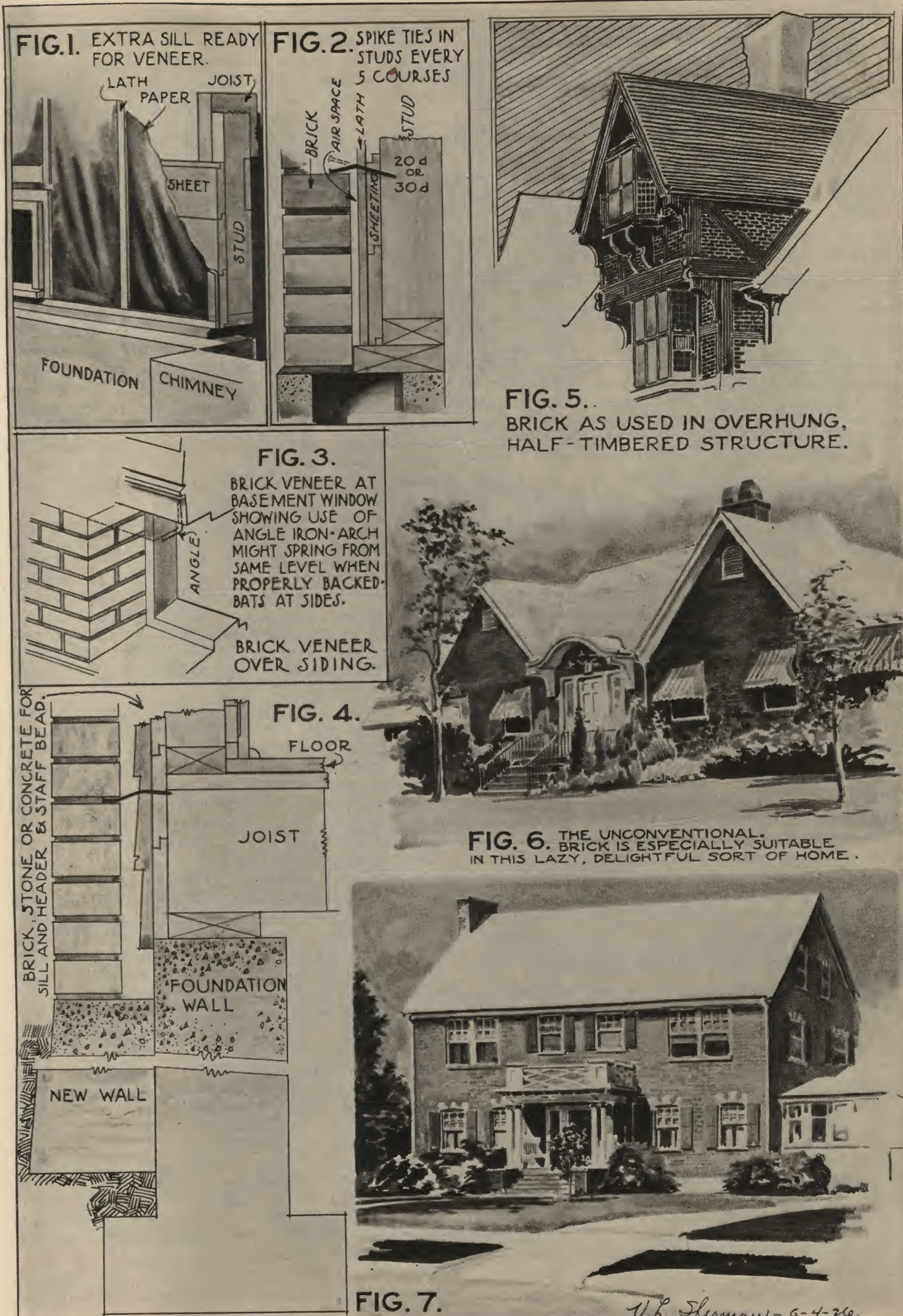
It is shown in Figs. 2 and 4 that an air space is provided between the brick and the frame. This is practically an integral space and requires no recommendation.

I presume too many "words" have been allotted to an unneeded defense of brick veneer. My excuse is merely that from what I know of this construction it is used altogether too infrequently. So many instances arise of unbalanced house costs that it is little wonder the high cost of building has become a by-word. If brick is wanted and fire-limits do not forbid there is no reason for not employing this type of construction.

In Figs. 6 and 7 are shown two homes in my neighborhood, both of good size, carefully planned and built for the owners, owners who have no intention of selling. They are both remarkably fine homes on excellent frontage. Fortunately some localities have been shown how successful this method is and have capitalized on it. The home shown in Fig. 6 is as commodious a bungalow as could be found. The environment pointed to brick, and a fine dark shade of brick with a generous roof covers a very hospitable spread of rooms. The particularity of the owner may be suggested by his hauling of flag stones of a particular variety from a particular spot for his walks.

The home shown in Fig. 7 is a larger one than the sketch shows, and more than ordinarily expensive in essentials which do not show casually. Its setting and size required brick. These two sketches are used to show that brick may be best for certain types, that brick veneer fulfills all requirements, that sounder judgment in the matter of costs may prescribe its use, and that there is nothing cheap about it.

Having got this far it may be admitted that refurbishing an old house by surrounding it with brick may have laid some foundation for the expression "veneer." But if the value of the house is proportionate to the expense what better means could be used to improve its appearance? An extra foundation, a solid wall to the cornice carrying its own load on angles or arches over transoms, and properly tied to the frame. Perfectly all right, unless some with more ambition than head try to support wall sections entirely from the frame.



Details of Brick Veneering

Brick should be thought of as a texture. It has its peculiar merits in house design which cannot be matched with any other means. Brick has the knack of light and shadow through its own lack of perfect uniformity. In a house the brick wall should never be blatant or even striking in its color but should be used as a foil for the decorative points. A house can be many things in brick which it cannot be in other material, for it will appeal to the sense as well as to the sight.

Hollow Tile

When I get rich, that is so rich that my lunacies will be spoken of as idiosyncrasies, I am going to build me a house of a certain kind of tile. This house will sit low on the earth and will rise up in a sort of warble of color; a key tone of slate gray, mixed with blue-black. That is to be the color of the walls. The roof will be a heavy flat blue tile reaching part way round two large chimneys of the same color in brick. The windows are to be all leaded casements, for I shan't wash them myself, and for the doors three or four heavy oak battens which I intend to steal. Or, if I am rich enough the house may require a real thatch roof.

Most of us are not rich, and many houses are built with a profit in the offing which, with the value of our neighbor's opinion, acts as a normal restraint confining our adventures to the charted areas. But my rambling has merely been around the fact that I like a tile house. One doesn't have to be crazy to build a tile house, but one may well be.

Generally speaking far more weight goes into the structure of a house than is necessary. One of the finest things in hollow tile is its comparative lightness. Thus it is not so likely to show local failures from its own weight as some walls are. And hollow tile walls, whether stuccoed or bricked or bare have great cellular advantages. By this is meant the large air cells within the tile and the possibility of insulating the inner surface of the wall from the outer when laying up the wall by stopping off the joints.

This last point may seem small to some but it is not. Any material containing unprotected capillaries or minute vessels will not only absorb moisture but will pick it up. The state of the inner portion of a wall then is governed by the amount of protection afforded by the outer portion. So far as mortar is concerned just try a piece and see, if there is any doubt. Now this pertains to the condition of moisture in the wall itself.

In the hollow tile asylum I intend to build for myself there is to be a heating plant which will deliver warm air within the wall. A sort of invisible heat to be admitted into the rooms through grilles in coves. This brings up another point in regard to tile.

Moisture in a wall and on a wall are two different things. The latter is called "sweat" probably because it does not come from within and because the surface is cold instead of warm. Any surface having a temperature lower than that which sustains the moisture in the air will collect its due of moisture from the surrounding atmosphere. For instance it is hard properly to humidify a house without storm windows because of the collection of frost on the panes in cold weather.

A wall of hollow tile is, or should be, dry within the house. No evaporation from its surface means no chilling from that source. The cells on the inner side, if furring is not used, are as susceptible to the house temperature and early morning warmth as the outer cells are to the weather. This reduces materially the chance of precipitation of moisture on the inner walls when the weather is damp but too mild during the day to run the heating plant.

Such action might be imperceptible if it did not leave an unforgetable odor. Even furring under plaster will not stop it and, except for climbing the stairs, that is my chief objection to basements. A cellar may be kept shut in warm weather and so protected from the moisture laden warm air, but a basement is to be ventilated.

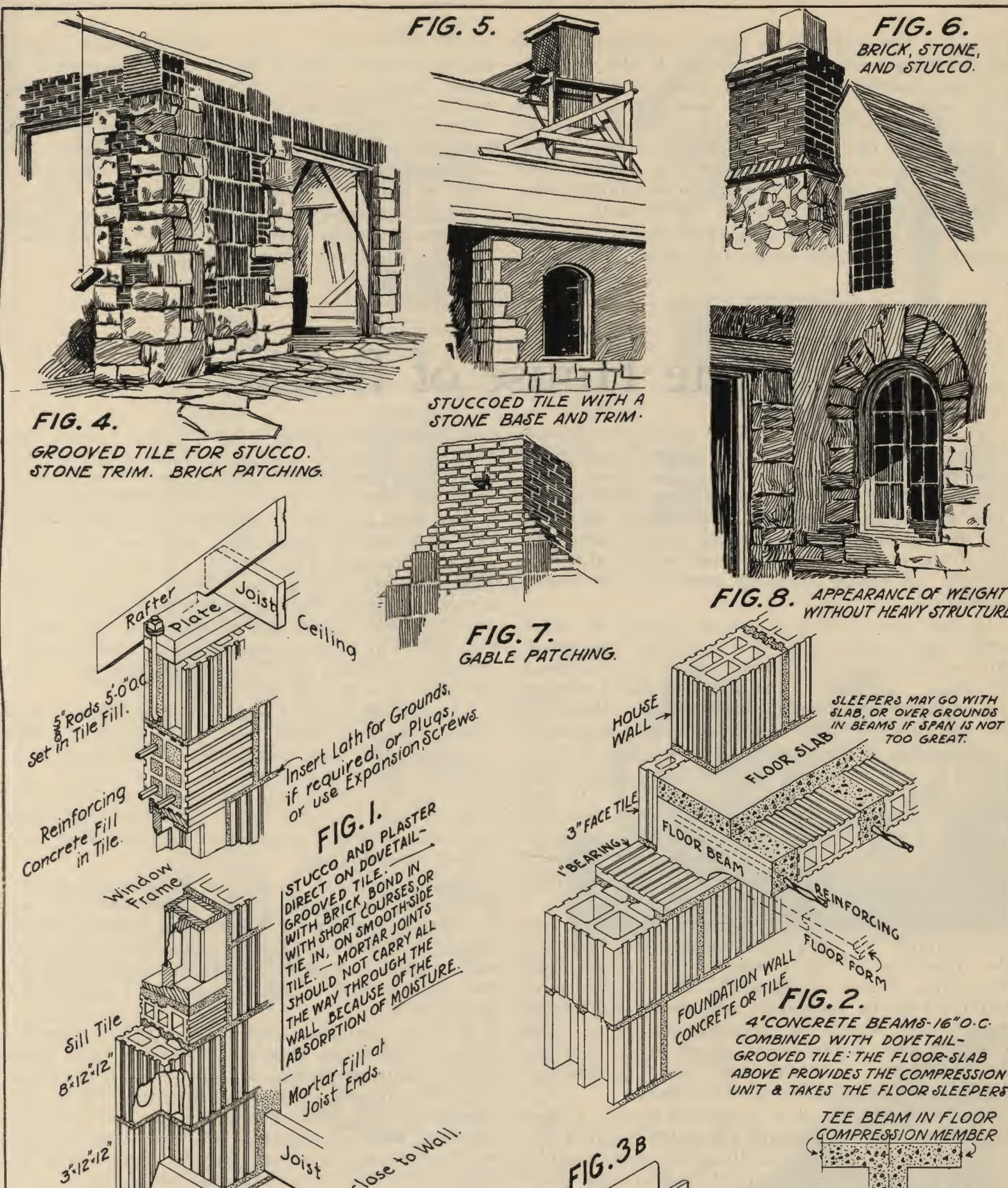
Sitting down to draw up the sketches opposite it seemed hard to settle on the material. Hollow tile is apparently exposed too little in house exteriors. It has been suggested here that when procured of good color a smooth, bare tile wall is attractive. There are some in this country but more across the water. A hollow tile wall will take stucco to perfection. Such a house can carry flat stone trim along with the stucco and produce a very solid, attractive mien.

As shown in Figs. 4, 5 and 8 it is laid up bonded and patched with brick at the intervals. This particular case is limestone and white rough-cast stucco, but divergence of color is sometimes more attractive. The present case contrasts with a vari-colored slate roof. The tile is plenty strong enough to take care of itself. Fig. 6 is a specimen of contrast that is popular with some and readily obtained. I don't happen to like it.

Brick backed with tile is very substantial. The hollow tile furnishes its own air cell so the brick may be brought up on the outer surface with flat ties used, or as is often the case bonded in on short courses of tile. This bonding gives a texture to the wall which is very pleasing. Pleasing is the word, because the satisfaction in a bonded brick wall comes from association with old things.

Fig. 1 is an isometric sketch of a house wall at the scale of 0.5 inch to the foot. This is one type of construction only. But there are two points to be noted. The roof, if of shingles, should be securely bolted to the walls. A hollow tile, or a brick wall has, of course no "give" upwards. This lifting strain is easily explained by noting the barometer on squally days. On a June day, when tornadoes were most promiscuous, the glass fell and rose nearly half an inch six times in 25 minutes. That meant nearly 30 pounds to the square foot difference in atmospheric pressure. If a house is closed these sudden changes do have an effect.

Figs. 2 and 3 are phases of hollow tile construction which interest me particularly. With timber



Structural Tile Details

joists the set at the plates must be substantial and the bridging brought close enough to the walls to prevent slackness at a border which is not boxed. Why not use slab floors? By means of hollow tile good concrete beams may be built as alternates over a form. The tile reduces the weight sufficiently to allow a relative heavy floor load with parallel reinforcing. The upper slab may be put down with sleepers in it, or spot grounds can be used.

In Fig. 3, page 35, the crossed tee-beams are quite apparent. The strain on the floor through the load and its own weight tends to sagging. This sagging strain produces tension along the lower side of the beam which is easily resisted by the net of rods. Such resistance then throws an opposing strain on the upper section of the floor which, being of solid concrete, is strong enough to stand its share. The advantage of a full tile ceiling on the lower side is often worth the trouble of a slab floor.

Along with this I should have run an exhibition of expansion bolts and screws. They are especially useful with hollow tile for fastenings.

The House of Brick

A recent article by a critic of critics bewails the constant superlative praises. It might be imagined from the trend herein that the writer never saw a faulty building, and that all building methods are alike wonderful. To the first the answer would be that poorly built houses are not under discussion, and to the second that, considered fairly and deeply enough, all sound building methods are really wonderful.

In the same periodical which housed the salty critic was another wail by a returning American; this one visioning the present bedlam to be followed by chaos. Evidently blind and deaf and receiving the vibration on supersensitive nerves. But it is this so-called "bedlam" which should be discussed.

Count over how many sound, new methods have grown up in the building business in the last twenty years without loss of the old ones. Go into any new home which uses all the arts to appear ancient, and then contrast its modern comfort and more intricate construction with the ancestral house which it nearly equals in mellowness. That is not prattle; there are lots of houses just like that.

This warped wailer turned my attention to our own vicinity. In point of time it is pretty new, but like thousands in this country I am blessed with "the house across the street." This house is invariably built by the couple who think that money and children should be invested, not spent. And in return the couple are a sound investment for the community, a vertebra in the building industry, and a source of irritation to the codgers.

This particular house is brick and stucco, a deep red brick which sets it back beyond the actual distance. It has no particular lines but is reasonable, a chief asset. Building in brick is becoming more common, but to me it is strange that there is not more building in common brick. Perhaps it is a peculiarity with me, but I like to see a house wall of common brick and blue mortar.

The variation in tone in individual brick tells a story. Brickyards hold as much attraction for me as collections of Indian flints. Now common brick isn't the weak stuff many imagine nor must it be hidden with paint. Common brick of good quality —that is, with the proper ingredients, mixing and baking—is sometimes more durable than face or stock brick.

One of the present features in the use of brick is the modern system of wall structures. In Figs. 1 and 2 the hollow wall is shown and I think that, with the exception of some few who did not like to see wall area increase at the expense of so many brick per day, this wall can be accepted as sound.

This wall is really a bonded wall as compared to the older hollow wall which was tied, and it has one disadvantage, the possible absorption of moisture. "Good" brick will absorb 10 per cent of their weight of water. But in such a wall, in this country, it seems highly improbable that the wall is very much at a disadvantage. At A and B, Fig. 1, consistency might call for proofing, and as F some recommend a trough and outlet.

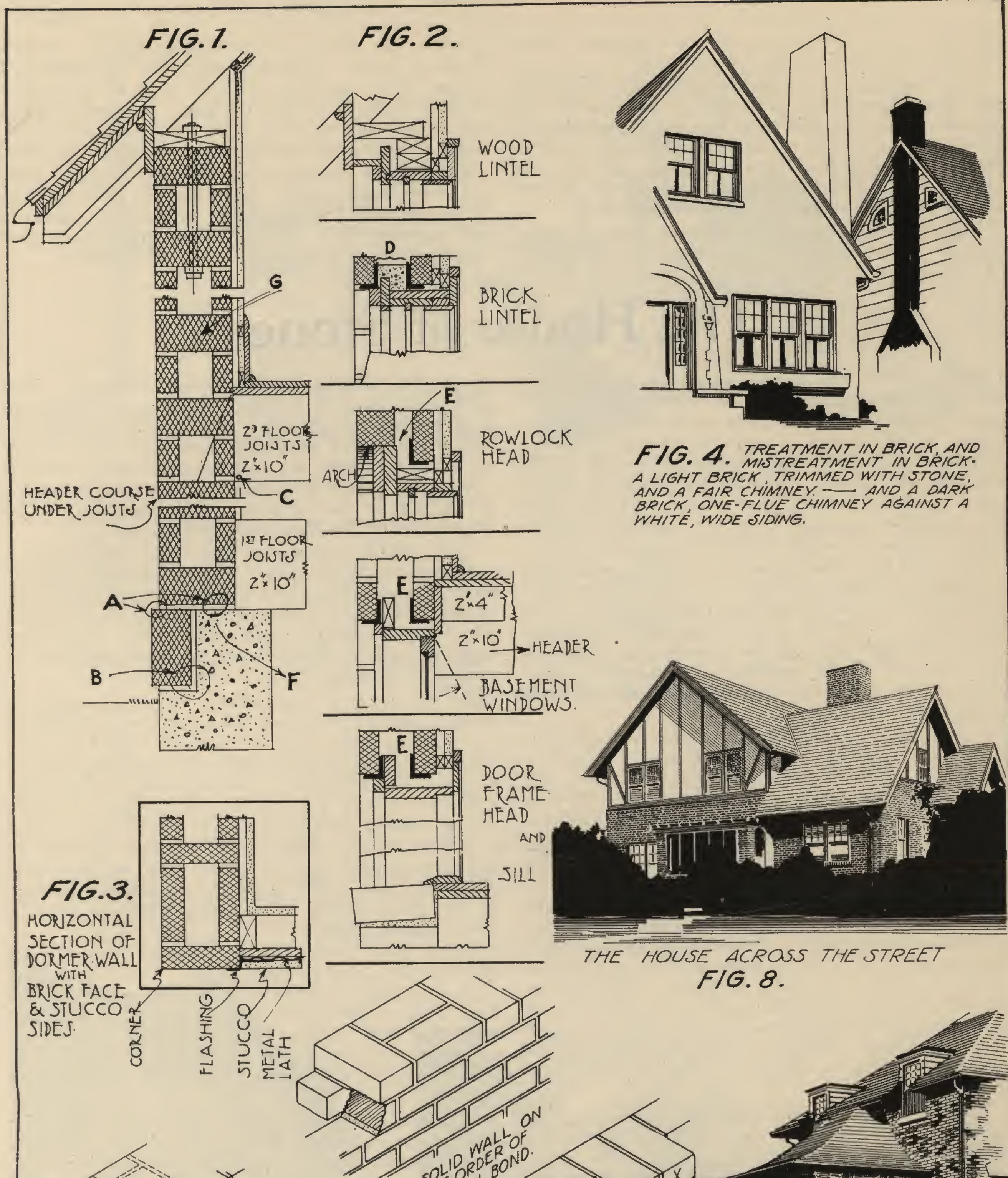
The first floor joists rest on the foundation wall. The second floor joists rest on the headers. How about venting and possibility of moisture at C. These joists might be tied in at the bottom (not the top), and free at the top to allow falling away without injury to the wall. But with the hollow wall some stiffness as the joist end should be guaranteed by bridging.

In Fig. 2, at D, it will be noticed the wall is closed above the lintel, but not at E. The arch may be carried through the wall and, according to some, should be carried through and the top of it proofed with asphalt. It will be seen in each of the E's that the framing is entirely open and unprotected from above.

But it is a question whether in this hollow wall a covered and water proofed window or door frame would endure more than an open one. If the frame is given a little more painting than the back of trim should get I question the advantage of a complete covering because moisture is a condition in wood from which we are freed only by penetrating the wood itself with a moisture proofing.

Solid wooden lintels are often used to good effect with brick if they are protected against shrinkage. They should be laid carefully and should not extend so far into the wall as to affect the distribution of wall loads. The same, of course, applies to stone lintels and sills. In the case of sills slip sills are apt to be the choice, but, in the latter case especially, enough pitch should be given the top surface to develop a good wash away from the joints.

While on the subject of water and moisture we might remark that bricks should be laid wet except in freezing weather when they should not be laid. Dry brick absorbs too much water except from the



Brick Construction Details

thinnest of mortars and produces the same effect that dry lath does in plastering.

In furring there is another point that is remarked as regards moisture. Wooden plugs inserted in masonry, or the equivalent course in wood, are apt to dry and shrink as the house dries out. Metal plugs and expansion screws do not, and are said to hold fast. These should be coated, and can be placed flush or extended to take mental lath.

Figs. 5, 6 and 7, page 37, indicate three of many types of walls. The economy wall with its minor pilaster has given great satisfaction in certain classes of walls. The different walls recommended by the brick associations have shown to advantage in their respective aims and need only supervision. But then some say any wall does need that, certainly a foundation wall or a footing for brick work.

I've had to dispose of a chimney footing from my own house which a keen-eyed foreman had broken up and "tossed out." (I think I'll make a rock garden of it.) But a wall of brick must have a sure footing.

The House of Stone

In an earlier article reference was made to advantages that might be taken in transportation of materials for building. That such advantages are taken is discovered by anyone interested in his travels. And stone, as a material, would surely come in this class. No building material shows more enduring beauty than stone, and for these two qualities sacrifice in other portions, for the sake of stone, is unquestionably wise.

You will hear that stone in a wall is subjected to chemical action through the atmosphere; that it becomes discolored, and mortifies both itself and the builder; that it is more in demand for formal town buildings and not for residences. But you may take all of this negative advice and still fail to cover the one positive fact that stone possesses the greatest suitability.

For myself I have far more clear recollections of stone houses than of any other sort. Along the west bank of the Fox River, north of Aurora, Ill., there is a fairly large gray stone house. It is a number of years since I saw the place, but I believe that its heavy flat stone wall with the thick, deeply raked joints would go down on paper very easily if I attempted to sketch it from memory.

So, if you are within reach of stone, or if the price of stone is low enough to be attractive, take advantage of that fact. There is enough variety in the characters of building stone and enough variety in the characters of walls to place a great many localities within profitable reach. To get down to cases, take the house known as the "Flagg type," or a modification. This, as shown in Fig. 6, has an air of its own, is as strong as it looks, and is far from expensive.

When limestone slabs, undressed, can be embodied in a concrete wall, and broadly pointed after the forms are removed to give such a pleasing wall, why hesitate? The cutting, dressing and expensive foundation work are left out and, for the type, nothing is missed.

Perhaps the previous rambling may be accounted for in the fact that stone is not used nearly as much as it should be on moderately priced work. It is a fact that stone is used in localities familiar with it and where the building is local in method and construction. Everyone on the lookout has seen fine examples of such work in so-called "out-of-the-way" communities.

Another point which should be considered in building of stone is decreased fire-hazard in country work. The time has come when suburban communities are encouraging out-of-town building because the suburbs are becoming crowded. Fire prevention must be considered and anyone building a permanent home away from the main centers, and putting in his own water and light plant, would be considered silly not to use every means toward a fireproof home, or a home which would be only a partial loss in case of fire. Stone houses are to be recommended for this very reason.

The building shown in Fig. 1 and Fig. 2 is a new one in Milwaukee. The foundation wall is block, cement and tarred without, carrying the usual wall plate, but with sufficient projection to hold a heavy concrete and stone wall besides. The house frame is built in the ordinary way, but with manufactured sheathing.

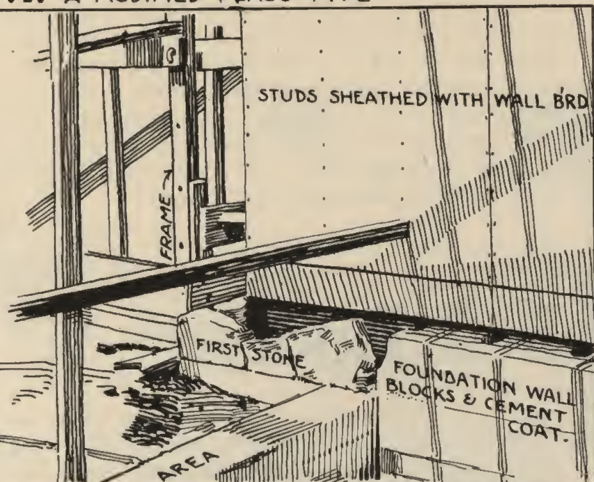
As the frame is completed a portable staging is erected against the wall which carries a platform for pouring and a form face even with the outer edge of the foundation wall. This staging is wide enough to permit easy handling, and, being wide, is plenty strong enough for the temporary form. As the wall is poured back of the first stone which is placed at the sill the platform is raised on its pins, more stone is faced on the form and the pour fills in around. This operation is continued on up to the plate, which, in a Flagg house, is usually lower than common.

Being lower, particular care is used in the design at the rafter foot to build tight. There is in this type a peculiarly desirable effect for small houses. The slope of the roof is used to distinct advantage while the wall volume is diminished. This effect, which is so common in Europe and was in this country during the Colonial days, had nearly passed out.

In stone work most faulty construction may be traced to faulty load distribution and poor footings. As compared to other types in building, however, mistakes are comparatively few. There are several reasons for this, perhaps the main one being that if a stone wall has a past you cannot hide it. A stone wall, then, is given more consideration from the very start.

An instance of usual forethought is shown in Fig. 4. These arches are different, of course, but it is apparent that all joints are located from the various curve centers. Or they are at right angles to the curve of the arch at the joint. An architect would say, perhaps, that the joint is always normal to the tangent of curvature. The first in Fig. 4 stresses this point, and such an arch would be strong or weak as the joints are carefully or carelessly reckoned.

FIG. I. THE BEGINNING OF A POURED STONE WALL· A MODIFIED FLAGG TYPE·



THIS WALL IS SHOWN READY FOR THE POURING-FORM. THE FIRST STONES ARE IN POSITION. THE FRAME FOR HOLDING THE FARTHER WALL IS SET·

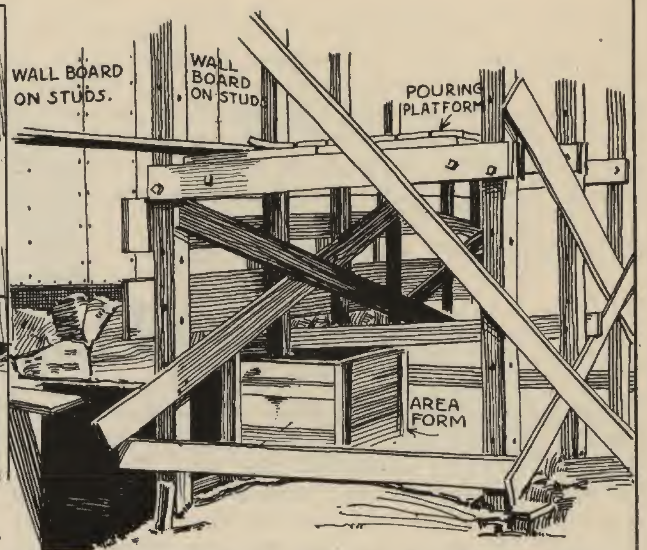
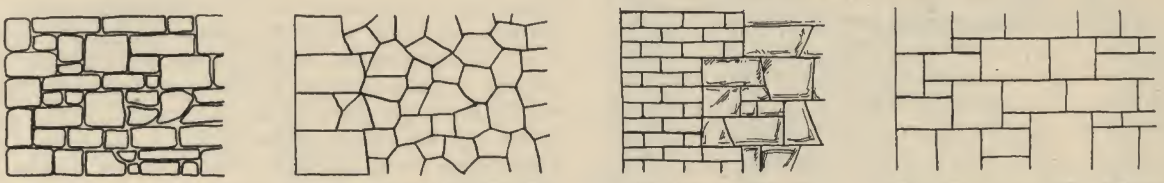


FIG. 2. FRAME IN PLACE· STONE SETTING STARTED ON SILL· POURING PLATFORM LAID WITH RUNWAY AT FAR END·



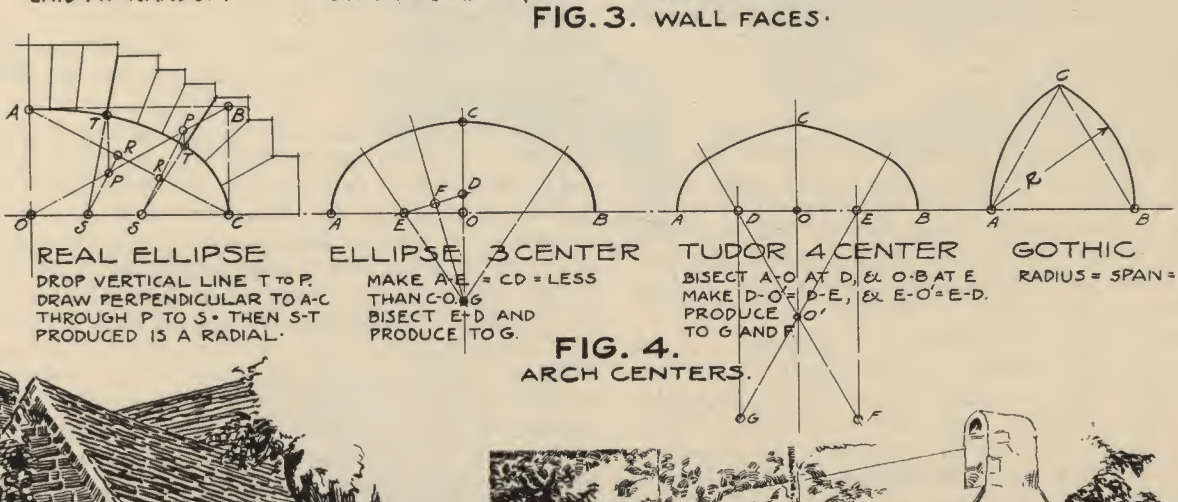
RUBBLE, UNDRESSED· LAID AT RANDOM·

RANDOM RUBBLE·DRESSED JOINTS·NO SPALLS·QUOINS·

DRESSED RUBBLE· BRICK QUOINS·

BROKEN ASHLAR· 3 SIZES·

FIG. 3. WALL FACES·



REAL ELLIPSE
DROP VERTICAL LINE T TO P. DRAW PERPENDICULAR TO A-C THROUGH P TO S· THEN S-T PRODUCED IS A RADIAL·

ELLIPSE 3 CENTER
MAKE A-E = CD = LESS THAN C-O. G BISECT E-D AND PRODUCE TO G.

TUDOR 4 CENTER
BISECT A-O AT D, & O-B AT E MAKE D-O'= D-E, & E-O'= E-D. PRODUCE TO G AND F.

GOTHIC
RADIUS = SPAN = RISE

FIG. 4. ARCH CENTERS.

FIG. 5. GRAY STONE LIGHT MORTAR RAKED JOINTS HEAVY SLATE

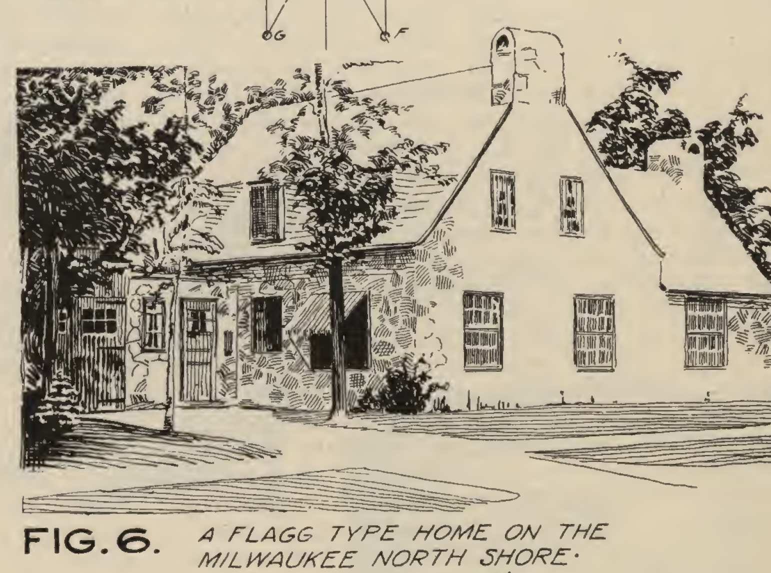


FIG. 6. *A FLAGG TYPE HOME ON THE MILWAUKEE NORTH SHORE·*

V. L. Sherman — 8-2-26.

Loads and resistances must balance. When a joint is not normal to the curve (or centered from the arch) the loss in resistance must be made up by friction at the joint or failure occurs. Friction in such a case is absolutely worthless and failure at one place involves not only the arch but the whole structure. Balance in an arch is as necessary as balance in the members of a truss.

In Fig. 5 is shown a very plain entrance. It is used here because it has been pointed out to me more than once as extremely attractive for a small type country home. When such a home is built the owner's first wish no doubt is to have the home, and especially the entrance, denote permanence and, if possible, age. No country-loving habitant likes to admit temporary tenancy.

The Thatched Roof

The folks around the corner were to build a six-room brick and half timbered stucco home with a thatched roof. I wondered just how they would go about it being no little interested in the modern American thatched roof and its diversities. I say this with all seriousness having seen the extremes of my likes and dislikes and everything in between. Lately my interest has become all the keener on finding that regular straw thatch has taken a new lease on life in England, a fact which may refute the claims of those who say that thatching, imitation or real, denotes punky moss without and mildew within. So far as looks are concerned well thatched roofs are in a class by themselves.

The success of a thatched roof depends largely on the shape of the roof. To demonstrate more clearly let us take the roofs shown in Fig. 1 and Fig. 2. The first is that of an ancient cottage, still flourishing. This thatch with all its curves it fairly integrated, forming a whole which stands as one roof, a cousin to the brick in the field. Its components are bound into one mass. In Fig. 2 we have a gable roofed bungalow of brick. Its size is such that an imitation thatch roof must have prodigious edges to support unbroken lines to any purpose. But, being conservative, the cornices (for that is really what they are) lose the effect altogether and, except for a first class job of roofing, the imitation thatch is a total loss.

A thatch should be uniformly irregular. In the American shingle-thatch the irregularity or serated effect at the edge is well attained in the irregular cut of the shingles and the gathering of the weather edges to form a wavy line of shadows. This is shown to some extent in Fig. 7. But in Fig. 2, the lines are not only very regular and relatively sharp but are emphasized by gutters which follow every eave to a corner.

Getting back to Fig. 1. It might be well to point out that such a cut-in for a dormer is not entirely satisfactory in American homes. Such cuts are prevalent enough in the old country and add greatly to the effect, but in shingling for that cut a heavy over hang is required (excusable in short lengths of eaves), and the windows are exposed to stiffer weather conditions than would be thought of in the old country. The true straw thatch can be cut away in pretty sharp lines, be bound and then loose itself in the main roof under a crop of moss in a very short time, leaving a shape but no edges.

There is enough of the thatch to lend itself to imitation without this. Hip roofs are common. Snubbed gables are still more common. Odd combinations are most common of all. The thatched roof is without guile; the cunning thatcher hides all this craft. So when pointing for a thatched effect build the lines with studied inattention, but bind them if possible into a continuous form.

For example take the near end of the roof in Fig. 5. This could have been built with the chimney rising closer to the wall and through the ridge of a common gable end. However, there is no call to bring straw thatch around the chimney face in weak fashion, and the snubbed gable can be brought up on a cricket inside, making a much snugger job of roofing. And in Fig. 5 the roof of the entrance vestibule is in part with the main roof. This is better by far than attempting a separate roof of such small proportions. The smaller roof adds to the main roof and to itself as well. Porch roofs of real thatch are frequently made quite flat and low as shown in Fig. 8. The camber to it is easy enough in straw but requires considerable work in imitation. And then the results cannot be anticipated.

There is good reason for "thatched" roofs in this country. They are more than imitation, but if they were merely that and good roofs they would help to relieve us from the thin roof structure of the thoughtless. Straw thatch would not do here at all. The weather is too severe and winds too high. Where the weather is usually moist and the moss grows thick fire hazards are not as high. Nor are the walls of our homes so often built of stone or brick or other fireproof material. But there is a homely quality about a thatched roof. In my opinion it is in its close knit appearance and its capacity to cover irregular outline with unbroken roof lines. Its apparent thickness declares warmth, the heavy edges ample protection from the rains, and its curved surfaces seem to mark stability. These, of course, are mere impressions of first appearances. Nevertheless they stick and linger in the mind.

To get this contiguity notice how the builder builds his hips and valleys. He is using formed cedar shingles, dipped and crated for the job. At the ridge he brings his rafters out far enough to chamfer the upper corners, forming a ridge of ample radius for continuous shingling. The dormer ridge is brought out thus and divided into double hips. These double hips are spaced with solid bridging, each piece having the radius of the ridge. The valleys are inserted with the same construction except that they are concave instead of convex. The rafter tails are separate pieces and the carpenter is obviously careful in setting them. But each has a curved edge which will be retained by the lookouts.

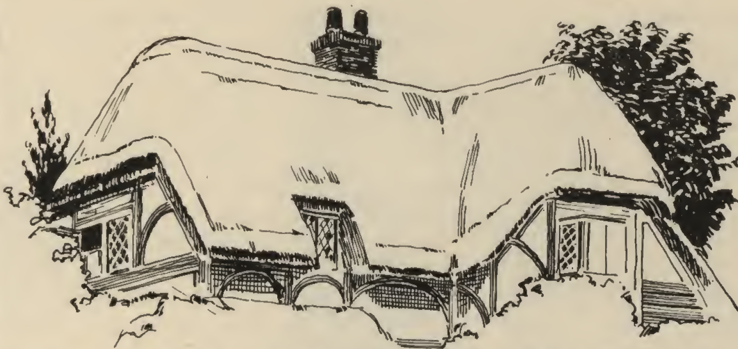


FIG. 1. UNIFIED THATCHING SLOPES FOUND ON A SUSSEX COTTAGE.

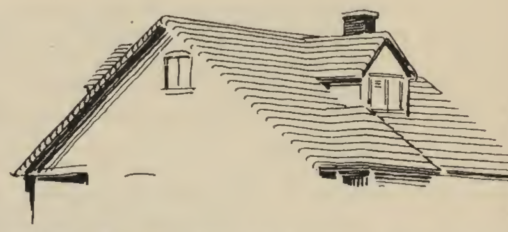


FIG. 2. *A FAIR EXAMPLE OF FINE THATCHED ROOFING MATERIAL ON A WRONG ROOF. THIS SHOWS AN ACUTE CASE OF CORNERS, UNBROKEN AREAS THAT OUT-SCALE THE CORNICES, AND A PREDOMINANCE OF CORNICE OVER THE EAVES. RIGID IN THE EXTREME.*

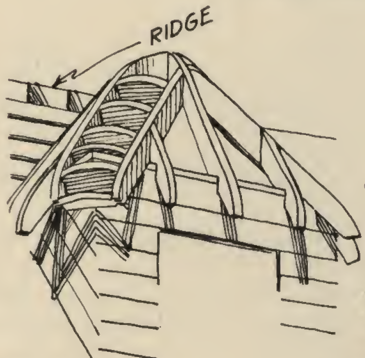


FIG. 3. FRAMING THE DORMER ROOF AND HIP ROLL.

FIG. 4.

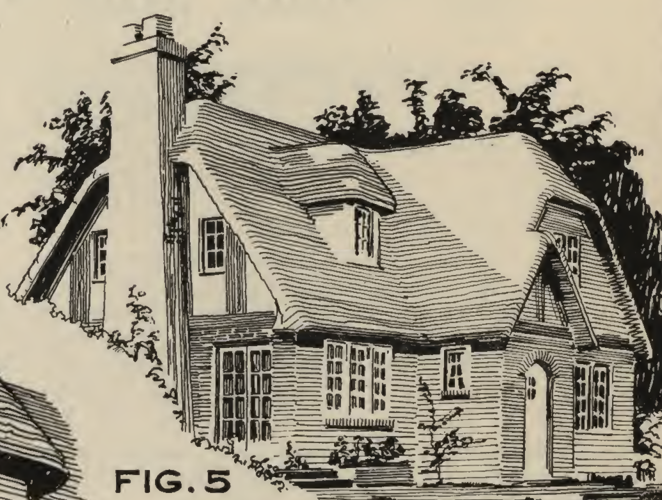
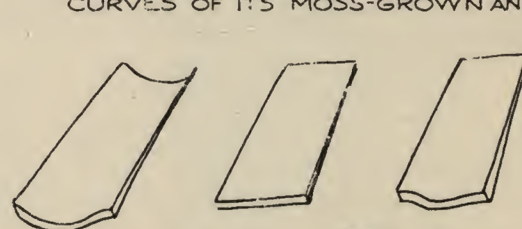


FIG. 5

THIS HOME, IN THE SAME TOWN AS THE HOME SHOWN IN FIG. 2, IS OF BRICK AND HALF-TIMBER. THE ROOF IN THIS CASE CLOSELY FOLLOWS THE CURVES OF ITS MOSS-GROWN ANCESTOR.

FIG. 6. FRAMING THE ROOF OF THE HOUSE SHOWN IN FIG. 5. BASKET ROOF AND FORMED CEDAR SHINGLES



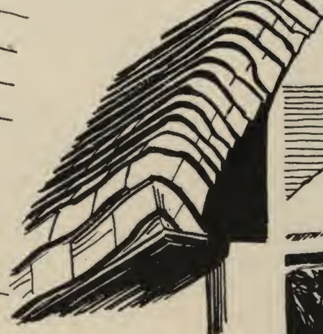


FIG. 7. THE ROLL.

FIG. 8. A NEW HOME IN THE "WEST COUNTRY". A TRUE BLANKET STRAW THATCH.

V. L. Sherman 10-2-26

The straight gable ends, as in the vestibule roof, Fig. 5, will be curved a bit more.

When the shingles are laid the first courses are set in carefully irregular, and with an eye to shadows. The cut of the shingles makes this fairly simple and the line of shadow does not have a choppy appearance when the curves at the weather end are matched up. The idea of getting a steep shadow on the wall and easing it into the roof surface with wavy shadow lines is quite a stunt, and it does the business well. A slight return at the ends of the eaves also helps.

Here we have the whole mass of roof without parting lines and with its edges blending into the deep shadows that it throws. If it is well built and well laid it partakes of the virtues of the old straw thatch while making a more substantial roof. If it is not well built and well laid that is another story and a discourtesy to the shingle maker.

To further emphasize my point let me use Fig. 8. This roof covers a rather large house. In fact it is the largest thatched roof in the district. But the whole mass is curves. It is so well arranged that its size and pitch, which is considerably less steep than is general, only seem to help the blanket effect. Such a roof would be odd enough to imitate but contrary to appearances it shows up in striking fashion and attracts the eye from a great distance. Whoever built it knew he had to exceed himself to match the view from his dooryard.

Slate and Stone Roofs

Two days out from Southampton we struck a gale which in all of its hilarious beauty made me think of shingles. I suppose the ever changing shadows of the waves, their ridges, valleys, hips; and a feeling of security in the ship, somewhat similar to the sense of security under a substantial roof in the same kind of a wind.

If this article on slate and stone shingles is as safe from windy enthusiasm, it would be very well, but in such a topic it is easy to yaw. There are two kinds of roof which elicit universal approval. Both are probably the oldest in civilization and will never be succeeded. They are slate or stone and tile.

The split stone roofs in the old wool-raising countries of England, romantically called the Cotswold district, are remarkably beautiful. In this district a good share of one's views on roofs comes from an elevated view point, and a roof just has to look good when the house proper is only secondary. Many houses there, small and large, have split stone roofs and so overgrown with moss that their age is a matter of guesswork.

What impresses one, however, is that a really superior roof, excepting of course for beauty, can be obtained from artificial roofing material. Experimenting seems to be nearly gone, since manufactured roofing has made such strides. So that it seems quite feasible to me in imitating a split stone roof to resort to modern products. Cement lips replace the inserted wooden pegs between the roofers, and if not rough enough to start with, a few might carelessly be handled with the best intentions. A stone roof is not underlaid with felt or laid with special care for alignment, but it is of all things a permanent roof, and needs no care until the house caves in.

The slate roof, which is also common in the Cotswold, is possessed of more variety than any roof I know. Fig. 1 is a sketch of a house-court quite common in the district. The main house roof is a smooth blue slate with weather lengths graduated down from the ridge. The greatest exposure to the weather is hardly more than four inches. The roof then in its long waves gives a fine even shading which contrasts well with a rustic porch roof of stone just below. There is a marked contrast in the shadows on each.

It may seem absurd to stress the matter of shadows on a roof, but the shadows really indicate the structure of the roof itself and consequently call for some attention. A slate roof should be laid only on roofs of one-third pitch or more. The steeper roofs are desirable because they show more of the surface ordinarily.

Slate roofs are to be laid carefully on felted sheathing and nailed to it with two rust-proof nails per slate. Where the thickness of slates exceeds 3/16 inch the nail holes are to be drilled and countersunk instead of punched. Slates should be rendered in slaters' cement for protection at ridges, hips, valleys and at junctures with rising parts or changes of pitch. Eaves and ridges should be double. From these points one may see that a slate roof has every idea of being permanent although, through slight inequalities of thickness, the surface may not be dead flat. Such monotony is not desired except in formal roofs for public buildings and such.

The real slate roof for small homes is the rustic, informal homely roof of unsquared edges or with edges sufficiently uneven to prevent slickness. The roofs should be quiet in tone if the house itself is featured with ornament, but with well proportioned plain walls it seems impossible to spoil the roof by overdoing color. With the first class of roof a little less surface of the slates should be exposed to the weather, with the latter exposure is often large enough to create splotches of color on the roof. With real slate this color is not too great because shades in slate are soft and not so great in variety as to look riotous.

But there is a chance to produce nearly identical results with manufactured roofing. I know a number of homes whereon such roofing is used in place of slate, both squared edges and ragged. After years of wear, the texture is just as good as it was originally, and still is generally taken for slate.

In Fig. 1 it will be noted that all of the pitches are steep. In Fig. 2 the pitches are less so. As a general rule slate does better on a steep pitch, and conversely steep pitches show slate to better advantage. There is in the present fashion of English roofs a real requirement for slate, and since such roofs can be made in such variety of texture and tone, both of the slate itself and manufactured roof-

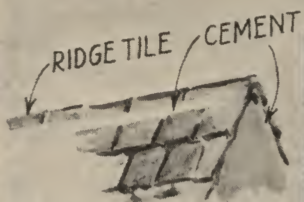


FIG. 3. DETAIL OF THE RIDGE SHOWN FIGURE 1.

FIG. 1. A SPLIT STONE ROOF OF THE COTSWOLD DISTRICT. A VERY ATTRACTIVE, COLORFUL AND SUBSTANTIAL ONE FOR STEEP PITCHES.
SAME EFFECT CAN BE GAINED WITH HEAVY RAG-EDGE FIRE-PROOF SHINGLES LAID TRIPLE AT THE EAVES AND BOUND OVER AT THE GABLE ENDS.

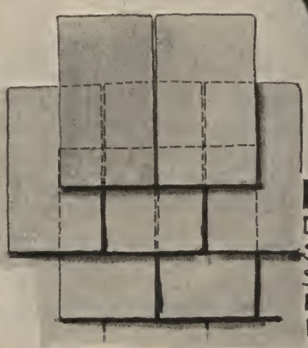


FIG. 4. 14" SLATE ~ $5\frac{1}{2}$" TO WEATHER ~ 3" HEAD COVER ~ SQUARED SLATE.

THE ROOFS IN FIG. 2 ARE EVEN-TONE, SMOOTH, UNIFORM SLATE ABOVE, AND LIGHT, ROUGH, SPLIT STONE OVER THE COURT. THE LATTER WILL MOSS OVER.

FIG. 5. UNEVEN, MONOTONE ARTIFICIAL SLATE. LENGTHS TO 20" MAKING FOR PLENTY OF COVERING STIFFNESS.

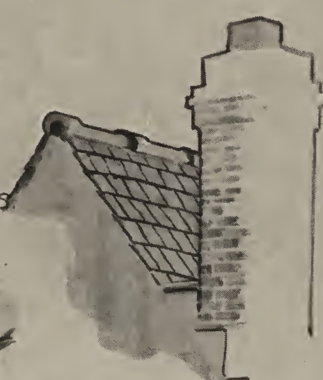


FIG. 7. HEAVY, CEMENTED TILE RIDGE AND A TILED CRICKET AT CHIMNEY.

FIG. 6. MIXED TONE, ROUGH-CUT SLATE MAKES EXCEPTIONALLY ATTRACTIVE ROOF ON A PLAIN STRUCTURE.

ing, a builder does not seek far for suitable material.

I may be wrong in this contention that artificial roofing slate answers the purpose in small homes, but such seems to me to be the case. When more size and expense are to be considered and with them heavier framing, it may be that real slate justifies its cost. It will outlast everything and likely outlast the house itself. After years of wear it will increase in beauty.

There are too many finishes for ridges, risings and so on to make any definite comment on advantages. I have been told, for instance, that a rough ridge will spoil a slate roof. Yet as in Fig. 3, page 43, where the tile and cement are as clearly visible as any patchwork masonry, there seems to be no distraction even when the ridges are uneven as they are in this case. Fig. 7 is taken from a country-council house, one of the general type and built with a good deal of regard for appearances.

When anyone becomes more than properly enthusiastic over a subject, their chief failing is the belief that all the merits of the subject are obvious. The slate roof enthusiast will not hold other types inferior because he has no reason to, but all he can consider in peace of mind is slate.

The Tile Roof

Tile has grown to a strong position in this country and is now common enough to lead many builders to try their hands at variety in roof structure. To many of us tile is simply tile, to them it means individuality in part with the character of the house.

In Figs. 7 and 10, an attempt has been made to show this contrast. The Moorish or Spanish style is tile-capped always, but with an informal effect which shows the generous use of tile. The tile is not always of the cylindrical form. The adaptations are, even here, from an older civilization and used to decorate flat, thick walls. The tiles are in fact a roof for walls, low or high (as we sometimes forget), and might cap anything from a 7-foot court or patio wall to a very tall house.

In Fig. 7, it may be seen that the tiles are thin, well over-lapped, but not keyed, and quite irregular. The cementing under the ridge tile is plainly visible and not considered a handicap to appearance. The wall surfaces at the location of the sketch were unbroken except for a lantern.

Now consider Fig. 10. The French tend to localize decoration. The roofs are of uniform pitch, hip and cone. There is an attempt at symmetry which is emphasized by the use of a small pattern French tile used throughout. Practically all of the decoration is furnished by door, windows, and grounds, yet any other roof would be at a disadvantage because of its lack of fitness or severity. The French use that form of tile well.

Tile can be used with slate, especially rough slate, as shown in Fig. 8. Such combinations are common enough in some localities and this one is shown merely to point to the fact that the use of tile should not be closely confined. It may prove its worth and beauty in many ways not generally accepted.

In Fig. 9, a concrete wall was gabled with a roll and a tile roof used. This sketch shows perversion. In the first place, the tile is apparently of the thin variety. The ridge is of the same form. The roof itself, then, while comparatively light, is sunk into a heavy wall. Evidently the extra strength of the walls is used to support a heavier roof beneath, and the tile is an afterthought.

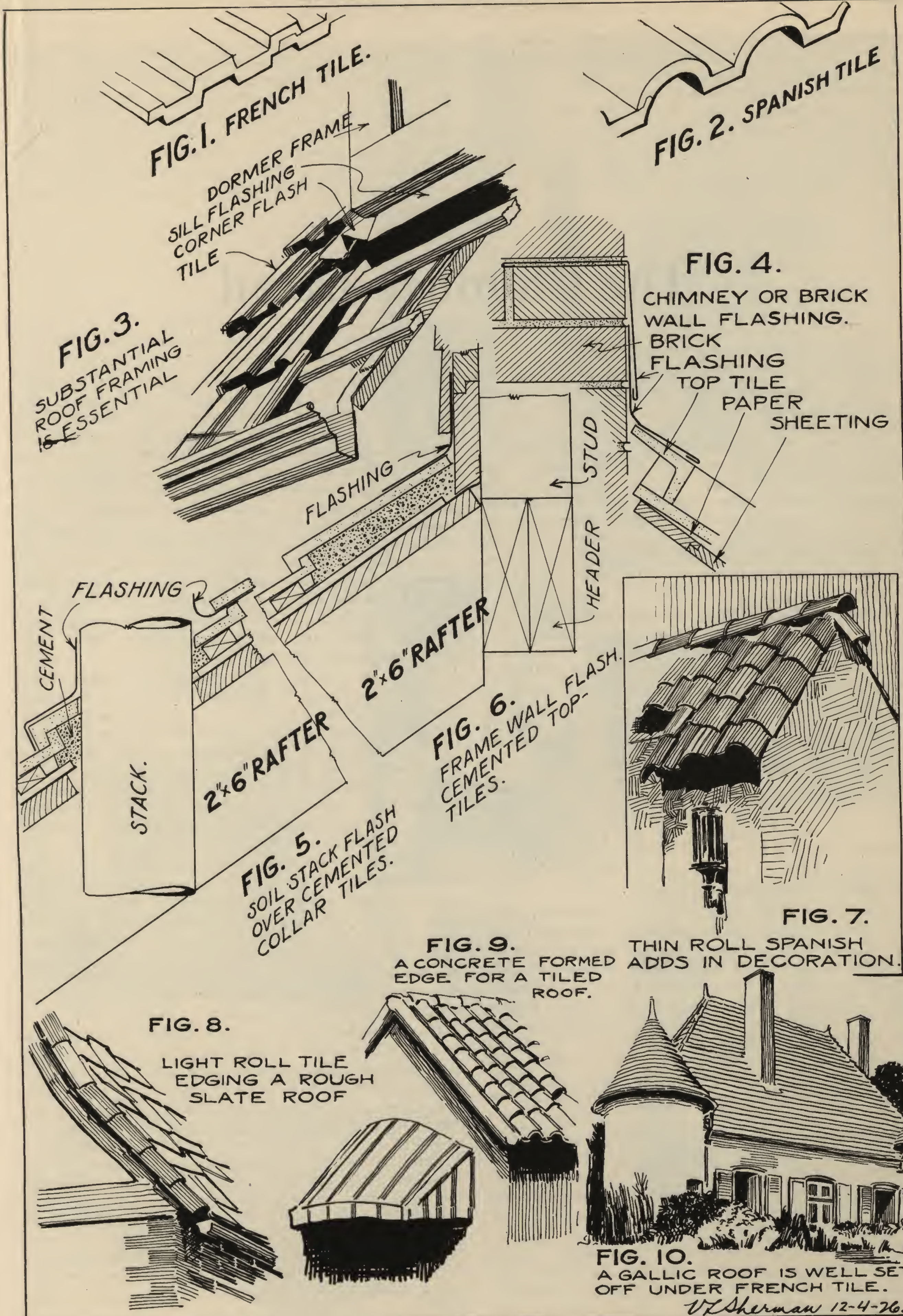
To get to the practical side of tile, note Fig. 3. Here we have a properly framed roof we will say, covered with paper which is strapped to the sheathing. Over this go the ledgers which raise the tile above the surface of the boards. The tiles themselves are poor conductors of heat, the space below the tile being dead air is a still poorer conductor. The result is really double roofing so far as conduction of heat is concerned. Considering the stiffness and projected area of the tile, even on a nearly flat roof, how little effect would wind have on such a roof. In an average square of tile roof, the surface is well protected from all the elements and the interior as well.

But when the corners are reached more care is necessary to do justice to tile. There is nothing elastic about it and skimping is likely to work havoc. No tile roof should be laid without particular pains to make joints with chimneys, stacks, or upper walls complete. Sound and liberal flashing should be used with cement bedding. To make it really worth while the flashing used should have as good prospects for life as the tile. Corrosion advances quickly in out of the way corners and with the slightest excuse. What profit then is a permanent roof with permeable joints. Far less expense is incurred where all metal engaging a tile roof is part of and as permanent as the roof.

A tile roof, like a slate roof, is brittle in its elements. So long as its form is unaltered it is as good as new, but such a roof is beyond help if the structure is weak. At times a sagging tile roof is noticed and seems to strike us as pronounced because we know by instinct that with uniformity gone, the weakness is general. The rafters and sheathing for a tile roof should be substantial. No questions as to strength should be allowed. While not nearly so heavy as many imagine, and plenty light enough for any real roof, it is heavier than cedar, manufactured roofing or slate.

The tile weight should be known and the framing computed therefrom. The irregular surface of the tile is likely to make snow-load more effective and that too should be considered. There is no hardship in such provision. Timber-strength tables are available to everyone and should be used. They save embarrassment. Some roofs we know do not fail simply because they lack temptation. That could hardly be said of tile, and perhaps that is why tile is so well liked.

Another point is this. As before mentioned the prevalence of the lower-pitched, hipped tile roof



Details of Tile Roofing

makes for needed caution. With rafter spans excessive, or with low pitches, braces should be sufficient to prevent sagging which might be normal in the timber but hurtful to the tile. I have seen such roofs braced after completion with success, but with a narrow margin for safety to the roof.

There are some failings, not very common however, but of which a few words might be said. They have to do with appearances and I should like to wind this up by repetition. Chimneys above tile roofs may be large but should never be small. They should be plain, never ornate. A good tile roof suffers from a contrast above it, although as a roof it may be in strong contrast to the walls below. Tile should not be placed on a light structure, unless its appearance is just as light. This is easy since many tiles are thin. But one of the best things regarding tile roofs is the opportunity for color.

The Chimney Detail

This is written in the interest of chimneys. To cast in the right direction it would be wise to quote Sam Johnson: "In these halls fireplaces were anciently in the middle of the room till the whigs removed them to one side." There is as much truth as wit in that remark. The common source of warmth was diverted for the sake of comfort and the privilege of a few and then came the chimney. This condition was succeeded, centuries later, by the common invisible heater, greater comfort and what was really a smoke stack. But the memory of an open fire has prevailed and again nearly all of us are seeking the fireplace and many of us are blowing money up the chimney with little smoke for company.

About one-half of the average homes are provided with a fireplace and a chimney to match. The first shows from within and the second shows very much from without. This phase of the matter is worth considering, why must a chimney show itself? Does it make the house more attractive? Is the outer wall the best place for a chimney? Would fireplaces be used if the chimney were not to be seen from the outside? These questions can be answered in two ways. But for those who love fireplaces and chimneys there is a single answer for each. There should be more fireplaces, larger chimneys, and more consideration given to both. A chimney does not have to be a feature of decoration nor does it have to be unsightly. Better, it should be a part of the house.

Or let's put it this way. Arthur, who is long for art, builds a house with an imposing chimney fronting the street. He spends a great deal of time on the drawing and more on the draft (I know a number of the sort). After he has lived in the place long enough to build a roaring fire on the hearth where he can sit in his shirt-sleeves and stocking feet, he hastily reassumes his habiliments and opens the doors and windows to let the smoke out. "Never again." You run across this type right along and they always begin with, "a fireplace is so dirty."

Another man builds a house insisting on an open fire and finally gets it. But this time the feature is rendered useless because the traffic about it is congested, and door drafts blow the soot and ashes out to be tracked about everywhere. It is given up as a bad job.

Now try the right side of the question. A chimney or chimneys should be located to provide the best accommodation for house fires and ventilation. They can beautify the walls or enhance the roof, but they will do neither when ill-proportioned for the job or then obviously decorative.

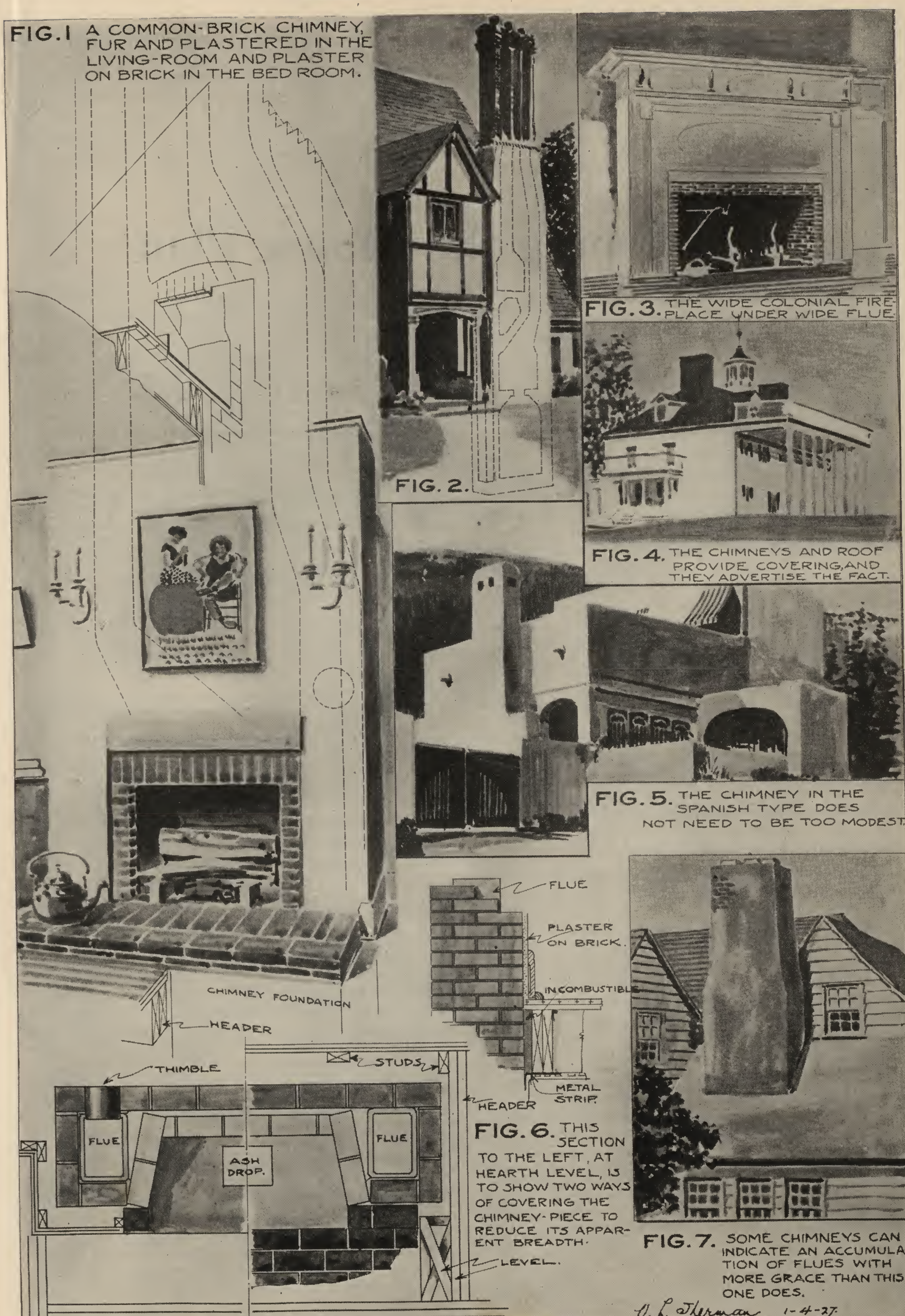
Fireplaces can be clean, cozy, and generous with their heat, facing sufficient floor space to allow this enjoyment without impedence. They can be built two and three into one chimney with enough left over to provide for the heater flue and a ventilating stack. (This does not refer to a soil stack which should never be built into a chimney.) The resulting chimney or chimneys will look as though it meant something to the householder and in the majority of cases will assume a beauty that doesn't smack of the drafting room. Fireplaces are clean, cozy and generous with their heat. I have enjoyed them since I can remember, still use them with wood and coal, and have never considered them a drudge or a luxury. They are worth many times what they cost and do not deteriorate with age.

Fig. 1 is a sketch of a chimney for three flues. This chimney was erected on a deep concrete slab over unexcavated ground and carries at the top three 8 by 12-inch flues. To increase the frontage in the living room the chimney was set back into the heater room where the space was less expensive per front foot. Since the bulk of the chimney would have been exaggerated in face brick the whole was plastered except for the trim. This is shown to the left in Fig. 6.

Directly over the living room fireplace is one in the bedroom. To avoid corbelling, the hearth is made of steel plate over a layer of cement which runs clear to the back and is lipped. And, to avoid two turns in the fireplace flue, the heater flue was offset above the second floor, the opposite flue rising straight. The exposed chimney could be shifted by reversing the flues, and the fireplaces could, of course, open from either side.

To the right in Fig. 6, is a similar chimney section in which more brick trim is exposed around the opening and the wall is set back. This is done when a chimney can be built within the two walls of a closet as such and gives the appearance of being flush with the main wall. There are many advantages to this arrangement. One is appearance. A small fireplace is much better put forward by being set back into the wall. The floor before the hearth is freed of the angles and turns of foot steps that are so much a part of a small living room. And the mantel may be dispensed with and no harm done. It may be surmised that it is a littered mantel which makes a housewife call a fireplace messy.

A pair of chimneys, each chimney having a little pulpit stair set against it, is very much a part of the



Ideas in Chimney Construction

house, and throughout the South, where fireplaces are used with real consideration, are these large chimneys of many flues, and, sometimes, many large flues, which take proper care of a hearth such as is shown in Fig. 3, page 47.

Some insist that a chimney in a Spanish type house should be hidden from view, feeling that the chimney has no part in such a design. In Fig. 5 the chimney is certainly toward the front and not disreputable. It is only apparently so when the dwelling is excessively decorated.

Each flue of a chimney should be designed for its particular job, neither too small nor too large and round in section if that can be. A circular flue spirals the smoke with less interference than a rectangular flue.

Developing the House Plan

Prospective clients are at all times prone to introduce pictures of houses into which shall be embodied certain features and comprehensive floor plans.

"The ever-ready victims they
Of logical illusions.
And in a self-assertive way
They jump at strong conclusions."

The anticipations of the client, be they ever so sweet, are not conducive to verse, especially if the clients cannot be convinced of impossibilities.

The picture in Fig. 1 is to be endowed with the third dimension. The picture is not merely the picture of a house, it is the house. The anticipations which it arouses, with little enough excuse perhaps, will be changed to forebodings if the builder fails in his regard for the picture. The house is to contain on its first floor a fair-sized living room opening into a sun parlor which may be used as an emergency bedroom.

The latter is to have a dressing room annex with a downstairs bathroom beyond. The living room is to open also into a kitchen-dining room which shall be provided with modern equipment easily sequestered from a refectory table situated before an open fire. The heating plant is to go on the same floor. Above stairs are to be a fair-sized bedroom, and bathroom, and a sleeping porch, besides plenty of storage. Delightful place it will be, out in the open country where mud is mud.

Placing the picture squarely on a larger sheet the horizon is found through right and left vanishing points. If the house is a bit out of plumb reset the horizon with the tee square. Draw a picture-plane line close above the chimney and bring the vanishing points up to it perpendicularly. Now set a steel square blade and tongue on the picture-plane vanishing points and fish for the station-point with the heel along the main vertical line. When the station-point is located draw lines from it to the vanishing points in the picture-plane.

Now draw vertical lines from all the essential points in the picture up to the picture-plane. In Fig. 1, the lack of such lines is regretted but necessary to avoid confusion. Draw lines to represent the near walls of the house in the plan view and draw them parallel to the lines drawn with the steel square and then go back to the station-point to note the effect.

From the station-point, diverging lines are passed through the marks on the picture-plane until they intersect the house walls of the plan view, and by this means the dream begins to take on a real shape. As can be seen from the plan in Fig. 1, the shape may have its disadvantages but with the visible features of the house properly located the dream may be interpreted.

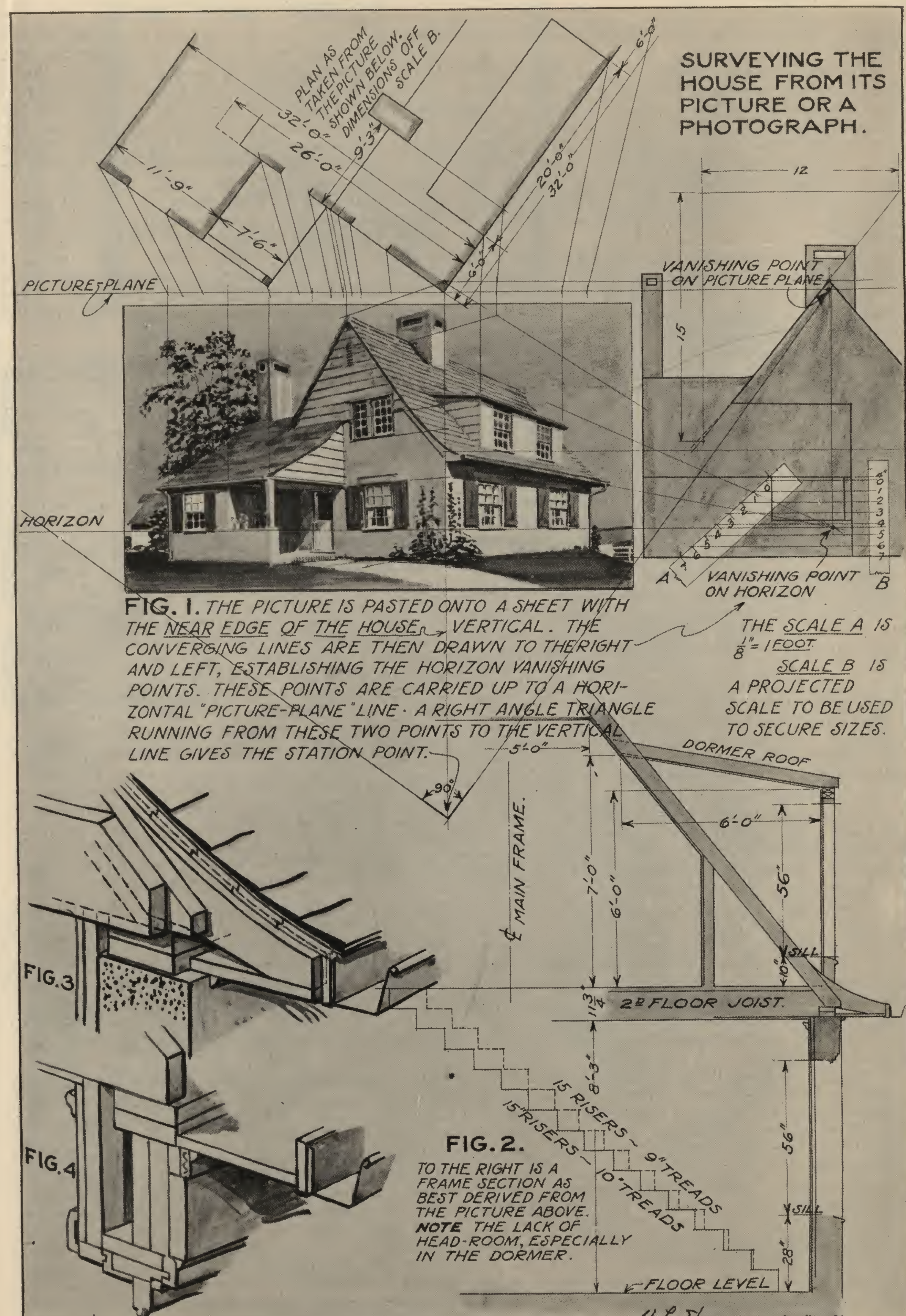
To do this lines are drawn from the main vertical lines to one side giving the heights in the scale of the picture. These heights, combined with the floor lengths taken from the plan, will form an elevation and the roof lines may be determined. Through unforeseen luck in this case the pitch just made a five-eighths pitch.

Next the height of some part is gauged by experience. The sample shows 7 feet 4 inches as the height from the floor to the ceiling of the side porch and this with a door 6 feet 8 inches. The 7 feet 4 inches is marked off on a diagonal to scale and projected to a temporary vertical scale. This temporary scale furnishes the respective sizes and should be accurately and stoutly made. It is usually a pesky thing unless made to read up to 30 feet, but is the chief reliance in living up to anticipations.

When the plan and two elevations are completed and transferred to normal scale various handicaps are more noticeable. The chimney rises too close to the near wall. The dormer is unquestionably low and, while the picture shows no such prejudice, there is scant head room all around the second floor, even with a low ceiling on the first floor. Going back to the dormer, such windows would be better farther from the floor but are hardly to be remedied unless the entire roof can be raised or spread.

A full section should be drawn exactly to scale before too much consideration is given. A large scale, say 1 inch to 1 foot, should be used. On this section should also be shown stair profiles for treads of reasonable depth and, if possible, a chimney and fireplace. If the materials of construction are not predetermined, sketches of sections at various points, as at Figs. 3 and 4, should be made for memoranda. They will tend to preserve the confidence of the client and make him open-minded toward rearrangements.

The whole trend of this is really unnatural, and sometimes impossible, but it emphasizes the fact that house planning is not for the guess-work of the irresponsible. No builder, much less a prospective owner, has any reason to accept as creditable a set of plans, or a perspective and plans, unless he knows their source to be reliable or unless he can check them himself. But if the mode of operation is corrupt the last result will be more engrossing than an impersonal affair and, contrary to the general belief, an owner appreciates all the builder's efforts to overcome difficulties presented. Even after rabid outbursts an owner will go back



Working Out Floor Plan From Photograph

to the same builder, in perfect confidence, with the next job.

The picture in Fig. 1, page 49, presumably shows the rear of the house. A photograph might be further analyzed to get the compass points, but the conjecture is that the jutting roof is at the northwest corner. The room arrangement is then a matter of consequence. Preserving the dormer on the south and opening a north dormer at the rear for the sleeping porch leaves that porch on the shady side and out of the common southwest winds of summer.

Resuming a discussion of the development of house-plans from a picture. It is of first importance to know something of the interior beforehand beyond conjecture. Some architects can forecast in their own minds when a floor-plan has been prepared. Some builders can do the same, and, perhaps with more accuracy, because of their experience. The ordinary mortal cannot. The writer of this is no immortal.

The floor-plan as worked out for the picture is shown in Fig. 1, page 51, and registers only one change so far. The chimney has been moved back along the ridge about 10 feet. Supposing the arrangement to be more or less acceptable according to the specifications for the 1st floor. There still exists in the mind of the future owner a desire to see something of the inside of the house. If he is a ravenous reader he will have seen in print sketches of many delightful interiors completely furnished with everything except owners. Some of these sketches are accurate drawings and some are very inaccurate; but to the ordinary mortal a distinction is hard. The sketch of one prize-winning breakfast-room, 9 by 10 feet, comfortably accommodated a dining-table, three dining-room chairs, a tea-cart, a floor lamp, and a chaise-lounge, besides a swinging door. Another, a second floor bed-chamber with a dandy little fireplace, took a dresser, chairs, and twin beds. When drawn out to scale the foot of one bed could have been used for a fire log. A new moon heralds this month, spring comes with the moon's full, and lunacy is especially rife. To the hopeful future owner I would say: trust to your architect's or builder's experience and the plans, but do not trust to the imagination of an illustrator.

To back the statement the drawings have been arranged for the opposite page to show how interiors can be gaged, just as exteriors are, by merely reversing one phase of the operation. These sketches over diagrams, Figs. 2, 3 and 4, are in fact more accurate than photographs because the vision limits are easily defined in a sketch, whereas a camera lens may overreach the eye or may warp the lines unnaturally.

Coming in to the hall the person stops at B, Fig. 1, and looks to the left as shown by the arrow. Assuming that his eyes are 5 feet above the floor, he will see about as much as is shown in Fig. 3. Should the door opening from the lounge into the heater-room be open, he will see more than the average hostess would deem necessary. Better swing that door into the lounge or from the opposite jamb. From this sketch a garish amount of wall space is shown along the south wall and room for a settee next to the fireplace.

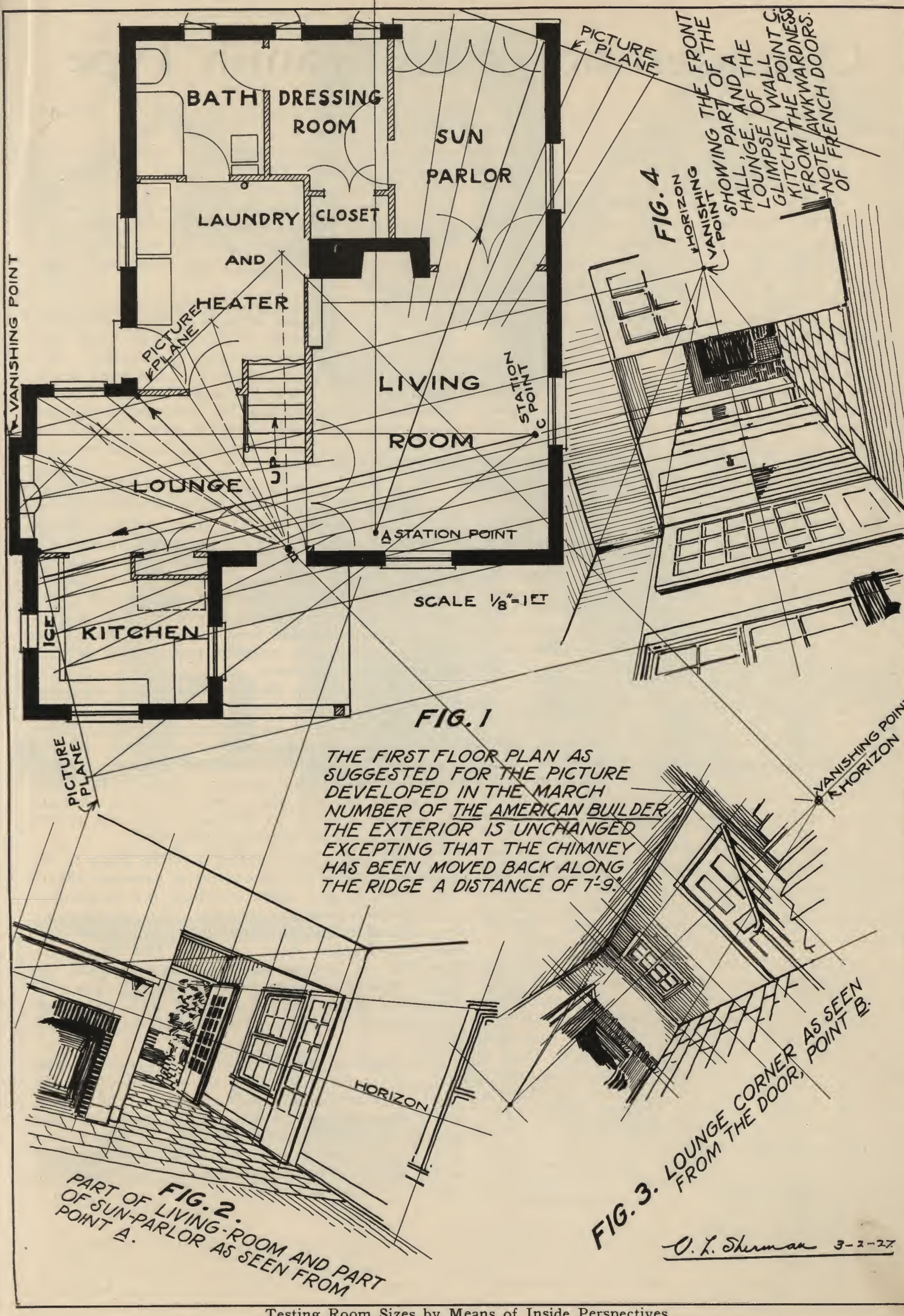
Turning in to the living-room, the observer stops at the point A to look toward the sun-parlor, as in Fig. 2. In this case he is given a chair and his eye level is about 3 feet 6 inches. Probably the first thing noticed will be a predominance of doors which, in a plan, look very innocent. According to specifications this sun-parlor is to double as an emergency bed-room. But for ordinary use the doors could happily be out of the picture. Better place a jointed door to the left, one which could be folded back against the chimney. This sort obliterates itself and does not cover usable wall space. A composition floor, when brought across with the hearth line, contrasts pretty strongly with the hardwood of the living-room. That seems open to change. Possibly the observer registers other items on his cuff and walks across to the window. Here he faces about and looks across the hall into the lounge.

Here again are noticed the unnecessary doors. The opening from the living-room into the hall should either be narrow enough to make the closing and opening of a door of little moment, and thereby accord real separation between the rooms, or there should be no doors. French doors properly used are to be appreciated. A coarse batten door would look well from the lounge side only. Here again from a scale perspective one can see the loss of wall space.

The kitchen is to open into the lounge. Not much of the kitchen-case is visible, and a step to the right would put it entirely out of sight. Such sketches show just how much of other rooms can be seen from any particular point, and it may be in order to say here that too little regard is given to a nosey pair of eyes. They are not welcome in any home and are especially active in homes that are poorly planned as regards doorways. Many owners would sacrifice personal convenience, furniture arrangement, almost anything to hide a bath room. Now take a straight edge, and by placing it in various positions on the floor-plan, Fig. 1, calculate the visibility of the bathroom from the sun-parlor or living-room. If the doors were moved to the opposite ends of the partitions how much would that improve matters. Try swinging the doors into the left. It is a curious game to play through the house but excellent practice.

All of this may seem outside the general run of house construction and entirely unnecessary—unless you have to live in the house. It is not however. Paper and pencil cost little. The time of one man, even that of a highly paid architect, doesn't equal that of a crew. And material is especially costly when it has to be ripped out. No good builder or architect but hopes for an uninterrupted job.

The construction of these sketches follows that shown on page 49. The picture plan is drawn in at 90 degrees to the line of sight from the station point. The various corners are carried over to the picture plan from the station point and returned to any suitable horizon in parallel lines. The vanishing points are carried down to the same horizon, and the floor, trim, and ceiling lines are run from their respective vanishing points as shown. Running out of the picture from right to left is easily detected because of the apparent absurdity of proportions. Sixty degrees is about the limit of vision, except for those gifted with wall-eye.



Testing Room Sizes by Means of Inside Perspectives

Characteristics of the Spanish Type

The discussions to follow on the characteristics of different types of homes relate to somewhat delicate subjects. The study of architecture implies a study of the history of architecture, but it should demand a study of history, or, better still, of tradition. Just now America is fortunate in having a variety of traditions from which to draw in building the more pretentious homes.

The Spanish type of home has a full quota of ancestors. Going back to the beginning, we contrive to find Spain with every type of climate, from a warm, moist west coast, up the hills to a sharp, vigorous atmosphere and landscape, across a dusty, flat, treeless plain, and down to a nearly tropical Andalusia. Weather of all sorts, topography of all sorts. Then we have the inhabitants. The original natives have lost themselves like the American Indian, the Romans control the country, the northern barbarians succeed the slipping Romans, and they in turn slip so far as to be run out of the picture by the spreading Mohammedans.

Rome always left her mark in roads, walls, bridges and monuments, especially masonry arches. The Goth at that time left nothing that was not useful, and he had little use for anything. But the Mohammedan, spreading from his tribal life in Arabia took along a patient culture of his own, picked up his workmen en route, and by the time he had dusted himself off and settled in Spain, he was ready to enjoy himself. Since he stayed there many centuries we hope he did, for some of his architectural marks are still worth striving for.

Taking it all around Spain is a rough land in some respects. Hence the Spaniard has exceeded most of us in methods of providing enduring comfort. His ease is not a matter of laziness, but a consequence of studied decorum. When he is at home he is certainly "at home." He is as much averse to spring house-cleaning as I am. And therein lies the secret of the Spanish type. It is devoid of dirt catchers. On this practical side we wish to point out that the plain stuccoed walls, tile and little or no paint, simple composition, awnings, or very plain shutters or grills, in fact, "nothing elaborate" marks the real Spanish house. For its chief characteristic we should put down "plain."

Now, "plainness has a closer relation to beauty" than any word I know. Most plain things have been relieved of all the non-essentials and are therefore comforting. And most plain things have arrived at that state by a long process which has provided better taste in selection. For example, Fig. 4 shows a house wall that would look blank to many. It is even quite Mexican and stands, no doubt, in a rather hot, bright locality. Suppose there were more windows, a pavement, and a show of roof. Would the place be comfortable to the eye and would the cluttered shadows show up so well? Scarcity of these windows and doors indicates that there is an inner court cool enough to persuade the owner that he is little interested in the stranger's viewpoint.

In Fig. 6 we come to a hill land and a more generous setting. You may notice here that the best type does not stickle for form or structure. The roof is cedar shingle. And a balcony roof is also shingled. There is not a whit of detraction in that. (If necessary you can put on wheat straw thatch and a five-eighths pitch roof and be as Spanish as ever.)

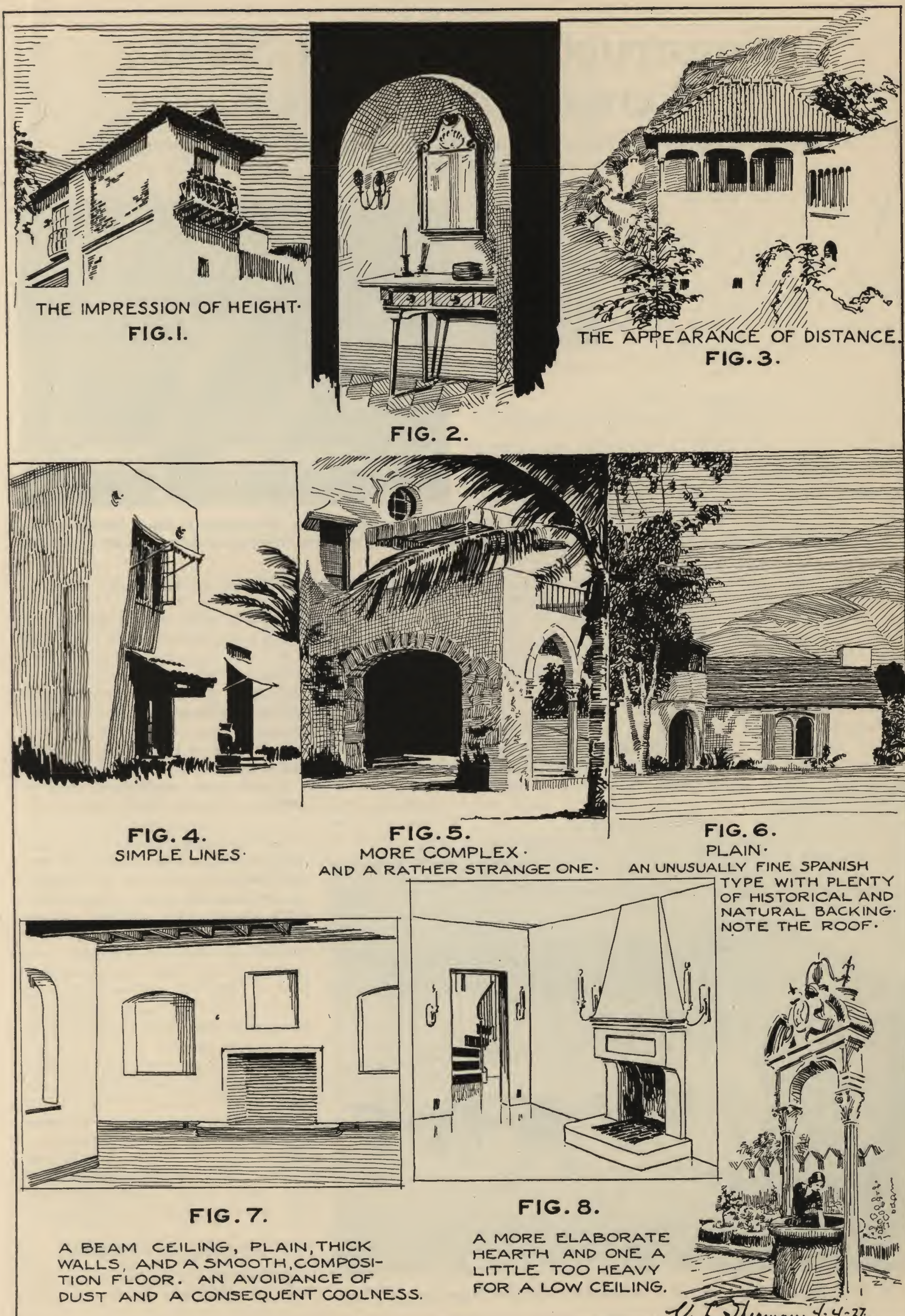
This house has a chimney where every one can see it. When you are tempted to hide the chimney to prove your Spanish style think of what chills Don Quixote suffered for lack of a hearth. Bear in mind, please, that reference is not made to the Mexican desert type of house nor to those localities where the real estate men never heard of a natural frost. This deals with such places as you will find in the western hills, or the plain ranchos, or along the warmer seacoasts.

Fig. 5 shows a porticoed entrance which includes an elliptical masonry arch and a pointed series on typical spindles. Both are true to form, but as separate examples. The inadequate Moorish pillars with the heavy ornamental arches are real beauty, even if the Moor themselves did bolster them with timbers, and they can furnish a fine contrast for the plainer background. But an elaborate background will tend to muss it all. These arches curtaining a walk or terrace will give inspiration to a gardener.

In Fig. 6 you will see a peeling stucco disclosing the rough masonry. The climate was too wet for the plaster, or so it was in Spain, perhaps. However, the wall would look better intact. Here it would be well to point out that Spanish types do not bar brick or stone masonry. Many of the handsomest are so composed. But what all of the walls do require is color, as Alhambra, the red, or the total of all colors, pure white.

On the inside the building is often plain in the extreme to allow an assortment of personal effects. More than in any other dwelling, the furnishings of a Spanish home are personal. Not knickknacks, or a set of period furniture, or "a few good etchings," as Bunker Bean puts it. The rooms are, therefore, on a more intimate standing, there are arches instead of doors, and consequently less trim. Since the owner may require to walk in or out more readily, windows reach to the floor in many places.

The walls are usually built for convenience with niches for shelves and deep set window ledges for seats. The fireplace is part of the wall, but a fireplace nevertheless. The ceilings may be low, beamed or smooth, or for coolness, as high as you like. The chimney shown in Fig. 7 would look much better under a high ceiling. The floors are smooth and hard and usually dark.



Characteristic Details of the Spanish Style

Construction Uses of Short Lengths of Lumber

Report of Survey by Department of Commerce and Central Committee on Lumber Standards

AS a part of the program of the American Lumber Standards a survey of the Construction Uses of Short Lengths of Lumber was made by the Department of Commerce and the Central Committee on Lumber Standards to determine the practicability of buying short lengths of softwood yard lumber for use in the construction of small and medium sized houses of lumber construction. A preliminary report was made at the May 1, 1925, General Lumber Conference in Washington.

This study shows that in twenty houses, taking 46,842 pieces of lumber:

32.70 per cent of the lumber is under 8 feet

10.90 per cent of the lumber is under 8-9 feet (both inc.)

56.40 per cent of the lumber is over 9 feet

That is, one-third of the lumber, which was delivered to the jobs in long lengths was cut into lengths less than eight feet during the process of construction while an additional eleven per cent was cut into eight to nine foot lengths.

Data and charts prepared by the National Lumber Manufacturers Association and presented at the May 1, 1925, Lumber Conference show that 5.3 per cent or about 1,350,000,000 feet of the total softwood yard lumber produced is under 8 feet and 6.6 per cent or approximately 1,680,000,000 feet is from 8 to 9 feet. The National Lumber Manufacturers Association further reported that lengths less than 8 feet can be purchased at an average reduction of about $6.00 per thousand for common lumber and about $12.50 for select lumber, these prices being f. o. b. mill.

Additional quantities of short lumber, mostly 8 feet and under aggregating about 4 per cent of our total softwood yard lumber production, might be saved by manufacturers if it were salable. Thus it is obvious that the purchase of short length lumber would result in national economy through closer lumber utilization as well as a saving in the price.

The possible exceptions to the use of short lumber, are joist and rafters. However, a saving of from 6 to 8 per cent can be made in these items if odd lengths are made standard.

Photo 1—Here Is an Avoidable Lumber Waste in the Overlapping of Joists Which Are Longer Than Required.

Softwood flooring should be made in multiples of 16 inches, especially that under 8 feet, and end matchings would be an advantage.

It was found that 89 per cent of the lumber delivered to the job in lengths of from 8 to 16 and in some cases up to 22 feet was cut into shorter lengths by the carpenters during the process of construction.

Experienced builders were found to have worked up their material very closely and what was left over was moved to the next job. Waste occurred with inexperienced builders or carpenters who built only one house and had no place to use their left over.

Four districts were selected in which this survey was conducted, namely: Washington, D. C., Philadelphia, Chicago, and Kansas City. Houses in Washington and Kansas City Districts were within the city limits. Those in the Philadelphia district were at South Ardmore, Pa., and Haddonfield, N. J. In the Chicago district they were located at Hammond and Gary, Ind.

Photo 2—Cutting 18-Foot Studs for Windows Is Another Unnecessary Waste.

The program of work limited the survey to lumber houses, that is those using siding, shingles, stucco, or brick veneer over lumber. In the two Eastern districts it was found that this limitation confined the survey to practically one size house which was a six room and bath dwelling. When a more pretentious house is desired, brick, stone or tile is used. In the Mid-West district larger lumber houses are built. The largest was found in Kansas City.

Grouping of Material

The material of the houses was divided into ten main groups and one

Photo 4—Short Sheathing and Studs Can Be Used Just as Well as Long Ones Between Windows.

miscellaneous group. Only one group was considered at a time when taking measurements. The groups were taken in about the order of erection as follows:

(1) Joist including joist, sills and girders when built up.

(2) Studding which are all exterior and interior studs, plates, heads and cripples.

(3) Rafters including show rafters or barge boards.

(4) Sheathing including that used on dormer windows and all other vertical walls.

(5) Roofing including roof boards and shingle strips, except ceiling over eaves.

(6) Sub-flooring including that used in bath rooms where tiled and on stair platforms.

(7) Siding including drop and bevel.

(8) Flooring including all interior top floors where made of soft wood.

(9) Porch flooring including all exterior floors.

(10) Ceiling including that used over eaves of houses and elsewhere.

(11) Miscellaneous including all other softwood lumber not mentioned above.

No inside trim, window or door frames, porch columns, stair trim, or other millwork or hardwood floors were considered; they being otherwise covered. It was observed that only two jobs used mill-made columns and that two of the builders made their own window and door frames. All cellar door and window frames were made on the job with but one exception.

Table No. 1 shows:

(a) The percentage of board feet in lengths up to and including 7 feet 11½ inches (under 8 feet).

(b) 8 to 9 feet (including both).

(c) 9 feet ½ inch and over (over 9 feet).

(d) Comparison of percentages in East and Middle West.

Joist

It is feasible to purchase short lengths for use in the construction of small and medium sized houses in every item with the possible exception of joists and rafters. In some short lengths can be handled to better advantage. Joists and rafters being load carrying members or beams with definite spans, the former governed by the size of the rooms and width of the building, the latter by the size and shape of the roof will not allow of the use of shorter pieces unless odd lengths are furnished. The ends of the joist are usually lapped on the girder or bearing plate as shown on Photo No. 1. It is claimed by some builders that this lapping adds strength to the structure but as these laps were not spiked together on any of the houses surveyed this claim is doubtful. One house had 12 per cent waste by lapping of joist. Most of the waste could have been avoided had odd lengths been available.

An example of odd-lengths use was cited by a Washington builder as having taken place in 1914 where there were a large number of houses being built on lots which were 17 feet wide, the houses being built in a row with party walls between and the length of the joist and rafters being about the width of the lot, or 17 feet. These joists and rafters had been cut from 18 foot lengths with a loss of nearly 6 per cent until an enterprising lumber dealer procured 17 foot lengths. By so doing he saved the builder and the ultimate owners many dollars, while at the same time he expanded his business greatly on these lengths.

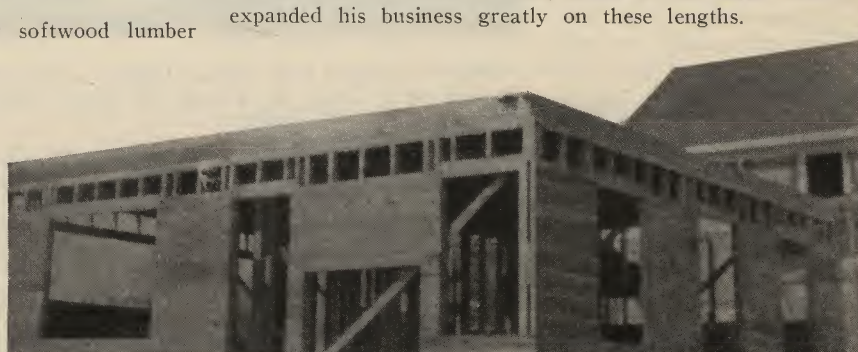


Photo 3—Here Is an Example of 7-Foot 11½-Inch Studs and Short Length Sheathing.

TABLE NO. 1

	Percentage in Board Feet of Lumber Used in the Construction of Twenty Small and Medium Sized Houses in the East and Middle West.				Comparison of Percentages used in Eleven Houses in the East and Nine in the Middle West					
		% B. F. Over 9 Ft.	% B. F. 8 to 9 Ft.	% B. F. Under 8 Ft.	% Over 9 Ft. East	% Over 9 Ft. Mid-West	% 8–9 Ft. East	% 8–9 Ft. Mid-West	% Under 8⅜ Ft. East	% Under 8⅜ Ft. Mid-West
1.	Joist	84.41	4.25	11.35	85.37	85.15	3.86	4.87	10.77	9.98
2.	Studs	28.92	28.22	42.86	36.49	21.80	23.25	31.90	40.26	46.30
3.	Rafters	75.66	5.34	20.00	78.73	67.68	5.10	5.95	16.17	26.37
4.	Sheathing	47.50	6.87	45.63	54.61	40.52	5.36	8.42	40.03	51.35
5.	Roofing	61.74	9.32	28.94	59.08	63.46	11.37	6.17	26.55	30.37
6.	Sub Floor	74.39	4.04	21.57	74.33	74.41	3.33	4.39	22.34	21.20
7.	Siding	50.53	8.09	41.38	52.87	44.45	5.57	14.82	41.58	40.73
8.	Ceiling	39.38	5.17	55.45	45.81	25.44	4.44	7.56	49.75	67.00
9.	Porch Floor	1.57	22.98	75.45	00.00	3.57	20.00	26.77	80.00	69.66
10.	Flooring	65.34	5.78	28.88	67.75	75.36	6.59	1.24	25.66	23.40
11.	Miscellaneous	44.88	6.51	48.61	34.04	50.30	1.94	8.91	64.02	40.78
1–3.	Total Framing	57.70	14.41	27.84	64.99	55.25	11.74	16.80	23.27	27.94
	TOTAL AVERAGE	56.40	10.90	32.70	54.50	50.53	8.54	11.48	36.69	37.91

Photo 5—Cutting 8-Foot Lengths from 16-Foot Pieces. The shorter lengths would serve the purpose just as well and effect a considerable saving of lumber and labor.

Rafters

In the case of rafters there being no chance of lapping as in joist the ends were cut off. One house observed required 16 foot 6 inch rafters which were cut from 18 foot lengths with a waste of 1.5 board feet per rafter or 8.3 per cent. A 17 foot length would have reduced this loss to 2.95 per cent, or a gain of 5.38 per cent. Roofs that are broken, such as hip, Jirkenhead and valley, require more short lengths than the plain gable roof. As the former generally have a better appearance than the latter it would be well to encourage the building of those types in preference to the latter. Where gable roofs are built the use of dormer windows would lead to the use of more short lengths.

Photo 6—Here Is a House Which Is Sheathed and Roofed with 1-Inch by 6-Inch by 5-Foot ½-Inch Car Roofers.

Studding

There was found to be considerable difference in the length of studding in the Eastern districts and the Mid-West. This was due to three causes:

(a) Ceilings were higher in the East.

(b) Roofs were plainer in the East requiring less gable studs.

(c) Balloon framing was extensively used in the East (See Photo No. 2), with two story studs while the platform type construction was used in the Mid-West using one story studs (See Photo No. 3).

On several of the balloon framed buildings all of the outside studs were set up full length, the window and door openings being cut in after sufficient sheathing had been nailed on to support the short pieces. (See Photo No. 4). The short pieces that were cut out were used in the openings where possible for heads and short side studs. (On one house 27 per cent of these full length studs were cut.)

In the other type of balloon framing all of the studs were cut accurately to length before assembling, thus making it possible to use short lengths over and under openings. The platform type (see Photo No. 3), used the greatest amount of shorts but it was observed that these pieces (usually 7 feet 11 inches—8 feet) were cut from 16-foot lengths as shown in Photo No. 5.

Two builders wished to know why standard length studs were not made the same as are standard laths, window and door frames and other parts. They said that as studs are already trimmed at both ends a step further should be made by trimming them to a standard length so that when delivered on the job it would be only necessary to nail them up. As window and door frames together with the spacing of studs are already standard, door and window heads, studs and cripples could be cut to standard lengths.

If standard length studs were used the height from one floor to the next would be standard thus allowing the use of standard stair framing.

These standard lengths would probably be 7 feet 9 inches, 8 feet 3 inches, 8 feet 6 inches, this being a sufficient range to cover houses as usually constructed. This would insure better construction as it is well known that a cut-off saw will trim more accurately than a man with a hand saw.

Photo 7—Eight-Foot Sheathing and 2-Foot 3-Inch Ceiling Were Used in This House.

Sheathing

The place where a large number of short lengths were utilized was in sheathing, as a large percentage of the long lengths delivered on the job were cut to go between window and door openings as shown on Photo No. 3. One house in Washington was sheathed and roofed with car roofers which

were 1 by 6 matched 5 feet 1½ inches long (see Photo No. 6), the studs being especially spaced to take this length. After this was on the builder was asked how he made out, he said, Say, do you know, I saved money on that job. Those roofers were so bundled that one man could easily handle them and they went on just like laths. I'm ordering enough for three more houses I'm building." Another house in Kansas City was sheathed with Byrkit laths which were 1 by 6 to 4—8 feet long the majority being about 6 feet.

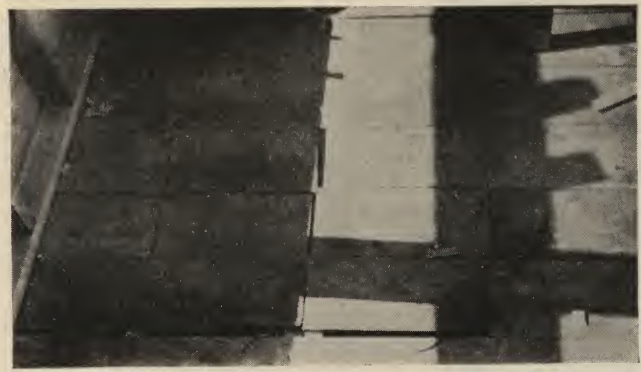


Photo 8—In This Sub-Floor 30 Pieces of 1 by 8 by 16-Inch Lumber Were Used Satisfactorily.

This was put on by the builder without comment or complaint, see Photo No. 7.

Wide sheathing was preferred by most of the builders because of the quick covering capacity but also several preferred it for the better bracing effect due to the nails being farther apart thus increasing the lever arm and making the building stiffer. Their contention seemed to be well founded for the nails in a six inch board would be from four to four and one-half inches apart while in a twelve inch board they would be about ten inches apart or a mechanical advantage in the latter case of 2½ to 1. Diagonal sheathing which has this desired bracing effect was not used on any of the jobs surveyed. It is understood that diagonal sheathed houses stood the cyclone in the Mid-West in March better than those with horizontal sheathing.

Roofing

The first houses surveyed were roofed solid to receive composition shingles. These houses were located in Washington and all the short ends left over from sheathing and sub-flooring were worked into these roofs. In the latter houses shingle strips 1 by 2 and 1 by 3 were used to support wood shingles. As such strips were not used, except a small amount of ends used for bridging, on any other part of the house, there were no short ends to work up, and therefore the lengths were longer and the percentage of short lengths less.

The use of short lengths on roofs is practical as may be seen under "Ceiling" where one man preferred 8 foot lengths for use over eaves. It was observed that short lengths were more easily handled on roofs when the wind was blowing and that they could be applied much quicker if cut to exact length in multiples of 2 feet, the rafters being spaced this distance.

Sub-Flooring

Another place where short lengths could be utilized was in sub-flooring, for though the percentage of short lengths shown in the table is not high it is due to the fact that sub-flooring and sheathing were usually from the same pile. The sub-floor being laid on a surface with few openings will accommodate long lengths and as it is usually laid before the sheathing, the left over ends were reserved to use as sheathing between windows. The possibilities for the use of short lengths in sub-flooring is shown on Photo No. 8 which shows some of the 30 pieces of 1 by 8 by 16 inches laid in one floor. There were also as many more pieces each 32 and 48 inches.

The waste due to laying sub-floor 45 degrees to the joist was estimated by different builders to vary from 5 to 20 per cent. No one seemed to know how much extra to order over the square measure of the floor. The general rule was to "order plenty."

A careful laydown of 8-foot sub-floor on approximately the plan of house No. 20 shows:

Loss where laid 90° to joist	3.62%
Loss where laid 72½° to joist	3.62%
Loss where laid 45° to joist (With square butts)	8.40%
Loss where laid 45° to joist (With diagonal butts)	14.50%

The reason for including 72½ degrees is that one builder in Gary laid sub-floors at this angle on about three hundred houses for the Gary Tube Works. The inspector on these houses stated that the top floors laid over sub-floors at this angle were more satisfactory than some that were laid over a 45 degree sub-floor. This method due to the slight angle used no more material than if laid at 90 degrees to the joist with the advantage of having the top floor cross the joist of the sub-floor as in the case of the 45 degree. The above estimates do not take into consideration losses due to surfacing edges.

Porch flooring shows the greatest percentage of short lengths used. There is only a small amount of this used and most of which was selected from flooring used in the interior. There was some objection to using butt joints in porch flooring due to the liability of their retaining moisture, thus causing decay. As most porches were about 8 feet wide it would seem inadvisable to purchase this in shorter lengths.

Ceiling

More short lengths were used in ceiling than in any other item, as a large number are used over projecting eaves of buildings. Photo No. 9 shows part of four hundred pieces 15 inches long which were cut from 18 feet lengths of Douglas Fir. The practice of cutting these short pieces was common with nearly every job surveyed, though the lengths cut from were usually from 8 to 16 feet. Photo No. 7 shows a workman nailing these short pieces to rafters. One builder used 8 foot car siding for ceiling. He said, "I like this because it is accurately cut to length and I can nail

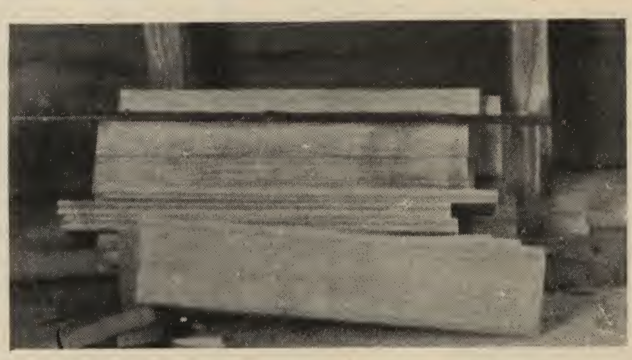


Photo 9—Short Lengths Could Have as Well Been Used to Cut 400 of These Pieces of 1 by 4 by 15-Inch Ceiling Which Were Cut from 18-Foot Lengths.

all of it without cutting my rafters which are spaced 2 feet on centers. I also made my porch ceilings the right width to take it without cutting." Most of the builders in Kansas City ran their ceiling on front porches across the long dimension to avoid unsightly butt joints. This if done elsewhere would promote the sale of more short ceiling.

As in the case of hardwood floors, there seemed to be no objection to the use of short lengths of softwood flooring. Much of this softwood flooring was laid directly over the joist (without sub-floor). In opinion of several of the

builders flooring should be made in multiples of 16 inches, especially those pieces under 8 feet.

House No. 6 used hardwood flooring laid directly on the joist. This flooring delivered on the job was found to contain a large percentage of short lengths many of which would not reach from joist to joist. This lot was rejected by the builder and was removed and another lot delivered. It was found that the second lot contained longer lengths and that there were none under 16 feet, however it was observed that nearly every piece had to be cut to permit of the joint coming on the joist, thus the good feature of end matching was entirely lost as nearly all the end matching was cut off. The waste in laying this floor was fully 8 per cent. If this floor had been made in multiples of 16 inches there would have been very little waste and the floor would have been superior as the end matching would have come into play. It was learned that some carpenters lay this flooring on the joist as it comes from the pile, thus very few of the joints rest on the joist.

Miscellaneous

In the two houses stair carriages or horses were made by nailing triangular blocks which were cut to the proper angle to give the required pitch on one edge of a 2 inch by 4 inch. These blocks were cut from ends of 2 inch by 6 inch with little waste as they came from alternate sides of the piece. When carriages are cut from solid dimensions the pieces or "points" are wasted.

Photo 10—Showing How Odds and Ends of Joist and Studding Are Used for Backing.

The percentage of loss of solid over built up is as follows for one carriage:

(a) Cut from solid 2" by 10" by 18'= 30 board feet

(b) using one 2" by 4" by 18' = 12 board feet

Using one 2" by 6" by 7' 6" = 7½ board feet ....19.50 board feet

Total loss..10.50 board feet = 35%

Belt courses and cornice boards were usually selected from sheathing and roofing material as it was found there were a sufficient number of pieces good enough to be used for this purpose. Bridging was made from ends of sheathing and roofing and in two cases from ends of flooring. Stair platforms were constructed from ends left from studding and sheathing.

In every case, as soon as the builders and carpenters understood the object of this survey, they were ready and willing to help, and in the majority of cases were of the opinion that short lengths from 6 feet up could be used and in many cases to better advantage.

Table No. 2 shows for each house the average length of each item tabulated, and for all the houses, total average length, and number of pieces per item.

House	Joist	Studs	Rafter	Sheath	Roofing	Sub. Floor	Siding	Flooring	P. Floor	Ceiling
No. 1	9.00	5.50	9.00	6.33	7.33	8.58	5.58	7.08	6.66	5.33
No. 2	12.15	6.24	7.66	6.07	9.91	7.16	Shingle	13.13	7.21	5.74
No. 3	12.16	6.25	7.66	6.08	5.41	7.66	Shingle	7.50	5.41	3.16
No. 4	14.83	7.00	15.08	9.16	6.58	6.83	Stucco	10.00	7.41	4.00
No. 5	10.83	6.00	13.08	6.50	8.16	7.00	7.00	None	7.66	4.00
No. 6	9.08	6.25	15.26	6.58	8.82	None	6.52	14.00	4.08	3.50
No. 7	9.81	6.00	12.08	6.33	8.58	11.00	None	6.91	6.50	5.83
No. 8	11.16	6.92	9.00	None	9.41	10.16	7.16	9.50	5.41	2.00
No. 9	12.33	7.91	10.58	7.00	12.00	9.17	Stucco	7.66	4.08	3.66
No. 10	8.95	5.87	7.22	5.03	9.64	8.17	Stucco	8.41	Cement	7.27
No. 11	9.94	4.49	8.68	5.67	8.90	None	Shingle	9.07	3.60	5.08
No. 12	9.00	5.25	9.17	None	10.92	9.50	4.17	9.50	6.66	None
No. 13	7.82	6.28	6.03	6.70	7.87	8.14	Shingle	None	Cement	None
No. 14	15.50	7.41	8.50	6.66	6.42	6.16	6.58	H. W.	7.25	8.17
No. 15	9.92	5.32	6.10	4.08	4.48	8.92	Shingle	4.36	8.00	Notfinished
No. 16	11.50	5.92	8.15	4.58	7.00	8.25	Stucco	H. W.	6.50	4.76
No. 17	8.29	6.34	14.45	7.07	6.68	12.08	4.48	H. W.	5.17	3.57
No. 18	11.04	4.45	9.71	5.72	6.69	9.06	Shingle	H. W.	Cement	2.01
No. 19	12.17	4.48	8.66	6.38	9.22	15.80	Shingle	H. W.	Cement	3.21
No. 20	12.25	5.58	9.25	9.33	9.08	10.66	Stucco	H. W.	Cement	3.33
Average Length Items	10.94	5.95	9.74	5.75	8.15	9.12	6.92	8.92	6.12	4.38
Average Length All Items	7.59									
No. Pieces	3,744	12,020	2,069	6,297	4,696	3,107	3,099	3,939	1,452	6,419
Total Number Pieces	46,842									

Table No. 3 gives the (a) builder, (b) location, (c) type of house, (d) number of rooms, (e) size of foundation and price of house not including lot.

No.	Builder	Location	Type	Rooms	Foundation	Garage	Price
1	J. C. Smith	Washington, D. C.	Lumber, 2 story Semi Bungalow	Six	24x30	In cellar	$8,500
2	H. L. Thorton	Washington, D. C.	Shingle, 1 story Bungalow	Six	22x35	None	8,000
3	C. M. Chaney	Washington, D. C.	Shingle, 2 story Semi Bungalow	Six	24x34	None	9,000
4	J. B. Higdon	Washington, D. C.	Stucco, 2 story Box	Six	21x34	In cellar	8,650
5	B. Lightbown	Washington, D. C.	Lumber, 2 story Box	Six	22x28	None	7,300
6	John King	Washington, D. C.	Lumber, 2 story Box	Five	17x25	None	5,000
7	T. L. Funkhausen	Washington, D. C.	Lumber, 1 story Bungalow	Five	25x30	In cellar	7,300
8	D. M. Keys	Washington, D. C.	Lumber, 1 story Bungalow	Five	28x30	None	6,000
9	Scroggins & Sons	Ardmore, Pa.	Stucco, 2 story Dutch Colonial	Six	22x28	On lot	6,500
10	S. Schifter	Ardmore, Pa.	Stucco, 2 story Dutch Colonial	Six	24x28	On lot	7,250
11	W. H. Andrews	Haddonfield, N. J.	Lumber, 2 story Dutch Colonial	Eight		None	6,900
12	Witter Bros.	Hammond, Ind.	Lumber, 1 story Cottage	Six	24x43	None	4,800
13	J. R. Charter	Gary, Ind.	Shingle, 2 story Dutch Colonial	Nine	32x33	On lot	9,500
14	A. M. Imes	Gary, Ind.	Lumber, 2 story Box Duplex	Six	22x30	None	6,300
15	M. Geromettia	Gary, Ind.	Shingle, 2 story Box	Six	20x22	On lot	4,600
16	H. W. Ruttinegeb	Kansas City, Mo.	Stucco, 1 story Bungalow, elv. sleep. porch	Seven	24x48	In cellar	8,500
17	C. White	Kansas City, Mo.	Lumber, 1 story Bungalow	Six	24x40	On lot	4,700
18	L. C. Bergsten	Kansas City, Mo.	Shingle, 2 story Dutch Colonial	Eight	24–6x31	On lot	10,250
19	H. H. Harris	Kansas City, Mo.	Shingle, 2 story Modified Dutch Colonial	Eight	32x32	On lot	8,800
20	F. E. Kraft	Kansas City, Mo.	Shingle, 1 story Bungalow, elev. sleep. porch	Seven	35–6x37	In cellar	7,950
							145,900

Low Price..............$ 4,600
High.................. 10,250
Average................ 7,295

Fire Stops in Modern Dwellings

SEVERAL years ago while visiting in an old New England village I witnessed the demolishing of an antiquated colonial house which stood in the way of our march of civic development. As the workmen were removing the outside sheathing I observed that between the studding, from sill to plate, there was what appeared to be a brick wall of about four inches in width from the first floor level up to and slightly above the level of the plate on the second floor of the house.

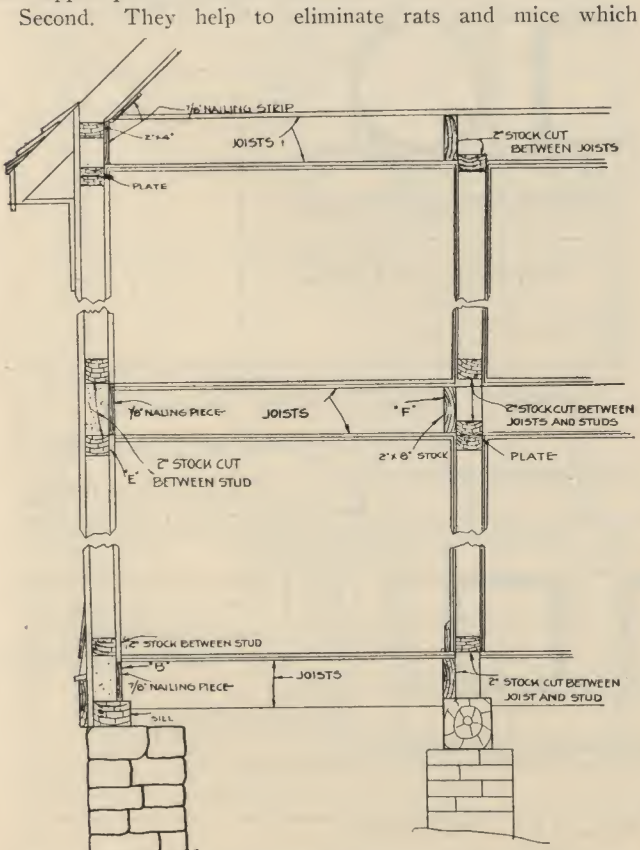
My curiosity aroused, I inquired from the foreman on the work if he could inform me for what purpose such a wall between the studs could have been designed. The answer I received was that it made the house warmer. There was a certain amount of logical reasoning attached to the answer. However, I was not exactly satisfied.

A little later I chanced to meet an old-time carpenter and builder and put the question to him. He informed me that the bricks or brickbats and mortar were placed between the studding to prevent a draught between the floors and to act as a fire resistant in case of a fire. Thus I became acquainted with what we call today, in the language of the modern builder, "Fire Stops."

The application of fire stops is, therefore, not a recent thought, but one which has been handed down from colonial days and only recently has been revived and put into practice again in our modern dwellings.

Fire stops in frame construction serve two purposes: First. A complete cutoff is obtained between studding and floors which is desirable in case of a fire starting in the interior of a partition. While the fire may burn through in time and reach the floors above, if the space between the studding is fire stopped at each floor level, it will have a tendency to retard the flames from spreading to the upper portion of the house.

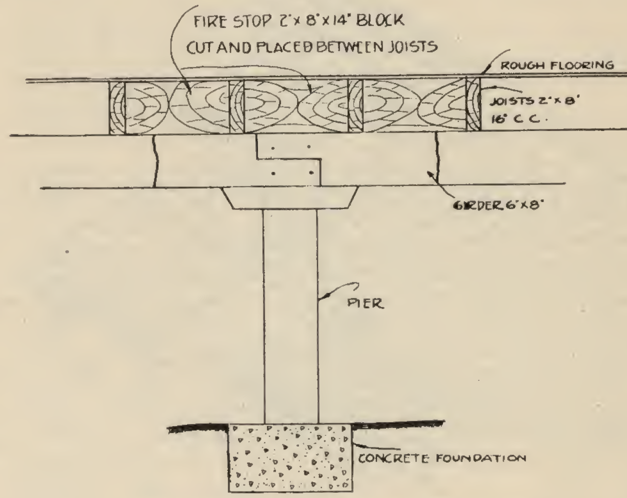
Second. They help to eliminate rats and mice which are, sooner or later, a source of much discomfiture to the home owner.



Economical Method of Fire Stopping in a Frame Building.

The accompanying sketch, showing an economical method of fire stopping in a frame building, is self-explanatory. However, it might be well to add a few words of explanation to assist in the reading of plans.

On the first floor level the joists are carried over on the sill to one-half an inch from the outside face of the sill. Upon the joists is placed the rough flooring, which is carried over to the face of the sill. The studding is started from a two by four plate which is nailed to the flooring. This plate cuts off any communication between floor and cellar wall. Between the joists in the cellar a seven-eighths nailing piece is inserted and nailed to joists (see B on sketch) which eliminates the possibility of a direct draft from cellar into the studding partition. I believe that this nailing piece is very important.



SECTION SHOWING FIRE STOPS BETWEEN JOISTS

If the house is constructed by the ribbon strip method a two by four block is cut and nailed between the studs just below the floor joists (see E on sketch) and likewise a two by four block is inserted and nailed above the floor level. The same treatment is carried out in the attic joists and in the cornices.

It is apparent that by this treatment we obtain an effective fire stop from cellar to attic which will decrease to a large extent the rapid spread of flames to the other portions of the house.

In the bearing partition the same idea is carried out (see F on sketch) with the exception that a piece of two by eight is substituted for the nailing strip. The heavier wood is desirable to stop the possibility of the fire spreading under the floors and prevent it for the time from spreading to the partition studding.

The plan is altered somewhat when plate construction is used. In this case the plates are doubled (two pieces of two by four) which act as a fire stop.

All carriageways are cut off by placing a piece of two by four between the studs.

The cost of cutting the blocks from odds and ends of pieces of two by four and two by eight and placing them between the studs and joists amounts in a two-family house to approximately $100.00. The additional cost is so small, when the relative value of the work is considered, that it hardly pays any home builder to overlook this important part of his house construction.

Building the Fire Safe Chimney

Proper Methods for Chimney Construction, Which Will Safeguard Life and Property Presented as Sponsored by the National Lumber Manufacturers Association

Simple, practical, and inexpensive measures to insure the erection of safe chimneys, flues and fireplaces are presented here. With defective chimneys, flues and fireplaces holding first position as the worst single structural, no feature plays a more essential part in reducing fire hazards than proper chimney construction. These fire hazards are common to practically all types of home construction. Too few communities recognize the importance of regulating by ordinance the erection of chimneys.

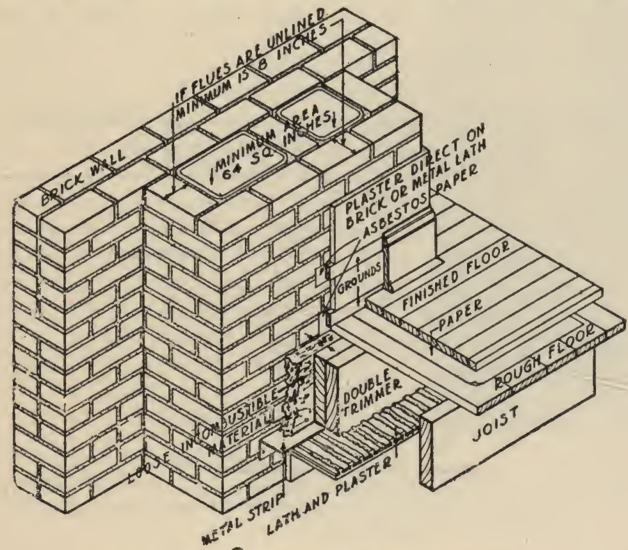


Fig. 1. Lumber Insulated from Chimney.

Build your chimney from the ground up. Let the foundation carry all the weight and be at least 12 inches wider all around than the chimney and placed well below the frost line.

Wood Insulated from Chimney

It is of the utmost importance that wood members be properly separated from chimney construction and not come into contact with any part of it. Ample space should be provided to permit the insertion of fire-stopping materials to prevent radiated heat from affecting woodwork, and also to guard against settlement in the masonry after construction is completed.

The method of accomplishing this result is shown by Fig. 1.

No wooden studding, furring, or lathing should be placed against any chimney, and all lumber-built construction should be set away from the chimney. In ordinary masonry wall construction, it is quite usual to imbed nailing strips such as lath in the joints between courses of brick work to which furring strips, or trim, are nailed. This practice should never be followed in chimney construction. No combustible material of any kind should be placed in joints of units making up a chimney. Plastering should be directly on the masonry or on combustible lathing and furring material. Furring strips around chimneys when used to support base or other trim should be insulated from the masonry by the use of asbestos paper, or equivalent material, at least one-eighth inch thick.

It is often necessary to erect a chimney with a stud wall

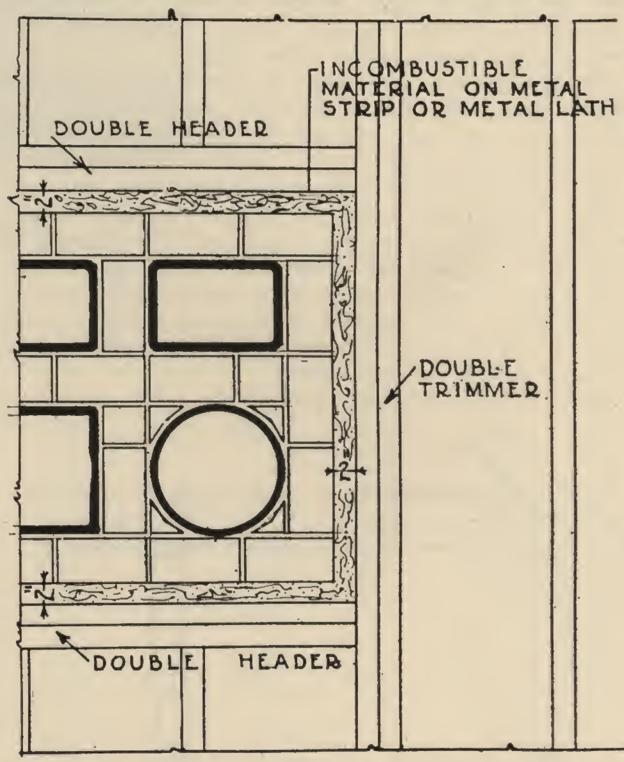


Fig. 4. Chimney in Center of Building.

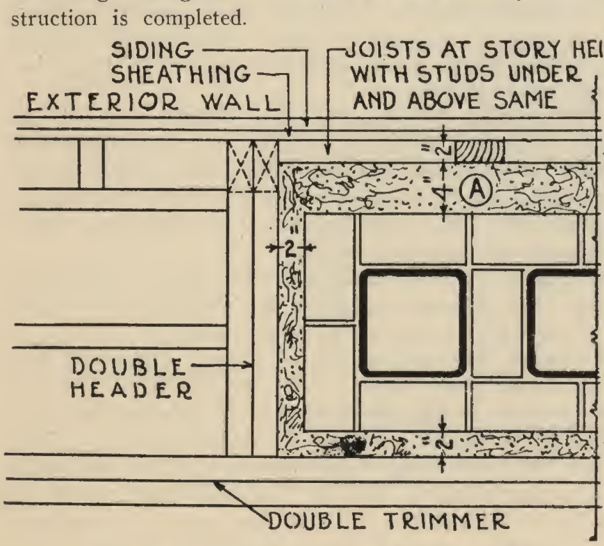


Fig. 2. Chimney in Outside Frame Wall.

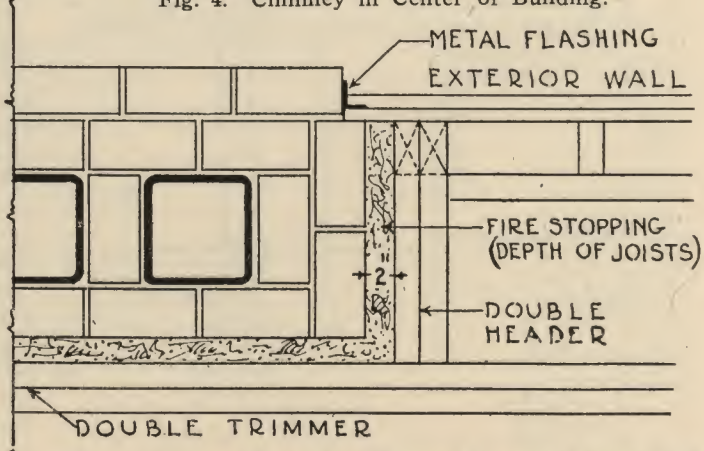


Fig. 3. Chimney Extending Through Outside Frame Wall.

on one of two sides, making it impossible to place plaster directly upon the chimney construction. When this is the case, the lumber studding and the joists should be insulated and separated from the chimney, as shown by Fig. 2.

Chimneys in Outside Walls

The foundation for an exterior chimney should start below the frost line. Concrete or masonry foundations of strength sufficient to carry the weight imposed without danger of settlement or cracking are required. A good weather-proof connection between the exterior stud wall and the chimney must be secured. The chimney wall in such cases should be not less than 8 inches thick. A slight offset should be provided in order that the sheathing may lap over and produce a right angled joint to prevent the passage of the elements. The lumber should be protected from the chimney by the insertion of asbestos board, or its equivalent.

This construction is illustrated in Fig. 3.

Chimney in Center of Buildings

An independent chimney is sometimes erected in the center of a building. The careless builder sometimes uses it to support the floor joists, sometimes adding a few inches of brick to the thickness of the chimney walls to support the additional load. Such construction will develop a very serious hazard. The shrinkage of the lumber members probably will not be the same as the settling of the masonry chimney. So in addition to plaster cracks it is almost certain that the chimney joints will open up and furnish opportunity for the passage of flame and sparks into the concealed hollow places between the joists. No lumber should rest directly upon any chimney construction. The joists should be supported around by headers and trimmers, as shown in Fig. 4.

Chimney in Masonry Party Walls

In many sections masonry party walls between buildings are common. Where flues or chimneys are a portion of such party walls the flues should not extend beyond the center of the walls. Their location should be permanently indicated on the exposed side of the wall, so that, in case of alterations, the chimney for the adjoining building may remain undisturbed and those who are making the alterations may maintain the proper separation of lumber members therefrom. An example of this and also of the minimum separation for the ends of lumber joists entering party walls is shown in Fig. 5. Where there is no right angled joist as shown in the detail, the separation between the ends of joists should be not less than 8 inches.

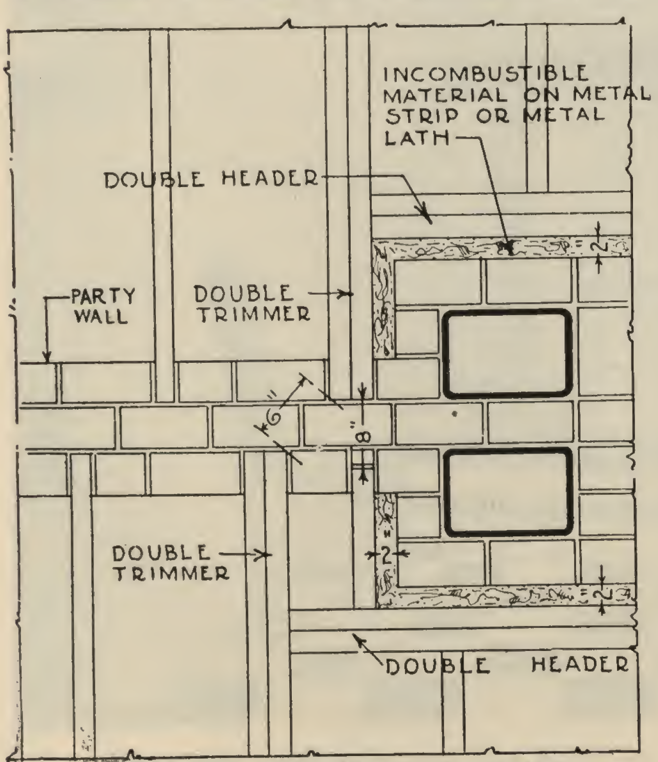


Fig. 5. Chimney in Masonry Party Wall.

Practical Pickups

Starting a job right in the beginning, even though it may take a little more time, always proves to be the most economical when you commence to do the finishing. In the beginning keep the long-run in mind, and you will not be sorry in the end.

Take time to take pains when you frame your rough openings for doors and windows, and you will not see so many chips fly later, when you set your window frames, or when you put the grounds on the door openings. Putting on grounds is a very important piece of work, although carelessly done many times.

If the jambs are made of ⅞-inch material, the rough opening should be from 2¼ to 2½ inches wider than the width of the door—wider or narrower than this will add extra expense to the job later. If 1⅛-inch material is used for jambs, 3 inches should be added to the width of the door. The thickness of the jamb should always be taken into consideration when a rough opening is laid out—unfortunately many mechanics lay out all their rough openings by the same rule. For both the cases referred to the rough opening, from the rough floor to the header, should be 3 inches more than the height of the door.

When framing rough openings, cut the timbers perfectly square—make the headers come on a level, and the sides plumb. Thus you are not only giving your work a mechanical appearance, but you are preparing the way for putting on the grounds.

There are several methods of putting on grounds employed by carpenters, but the best way that we know is the double-straight-edge gauge. Take two straight-edges 6 feet 8 inches long (if the doors are 6-88 doors) and tie them together with two cleats, say, put a cleat about 18 inches from each end. Make the distance between two straight-edges equal to the width of the jambs, which usually is 5¼ inches for 2 by 4-inch partitions. A little block about ⅞ inch by 1¼ inches, fastened halfway between the two straight-edges onto the cleats will hold the gauge away from the rough work enough to permit the grounds to be slipped in. The setting of the gauge is an easy matter—start a nail at the center of each cleat, in such a manner that it will go through the little block. This done, set the gauge up to the rough jamb and drive the upper nail into it, being careful that the gauge will allow an equal amount of space for plastering on each side of the partition. Then plumb the gauge and drive the bottom nail. The nails should be driven so they can be pulled with a claw hammer. When the gauge has been set, take common lath with one edge straight, or nearly so, and nail them to the rough work, keeping the straight edge against the gauge. Having the grounds on one side of the opening, set the gauge on the other side, and put the grounds on there in the same way. For the grounds overhead, take two perfectly straight lath, cut them in length to the width of the opening, and nail them so they will intersect with the side grounds. This method gives better results and requires much less labor than the old system of using a single straight-edge and a gained-out gauge.

With the grounds on right you will not only get a better job of plastering, but the jambs will be easier to set and the casings will go on better; thus the finished work will have a good and workmanlike appearance.

Concrete Floors for Residences

In Which Some of the Popular Fallacies Regarding Concrete Floors Are Cleared Up and Good Construction Methods Suggested

"CONCRETE floors in your new residence?" The very thought of it would bring to many women a vision of rheumatism, numb feet, chilblains and broken arches. The greater proportion of non-users probably believe that concrete floors, used throughout a residence, would be cold, damp and tiresome, the direct antithesis of what a good floor should be.

But what of the finest new hotels and apartments, school houses, hospitals and palatial residences? All of them have concrete floors. Hotels are competing with each other to give the traveler what will please him most and serve his purpose best; schools and hospitals require the ultimate in firesafe, quiet and footsure flooring; the palatial home also requires these qualities and in addition a substantial structural floor upon which may be placed a variety of floor coverings selected for their utilitarian or decorative adaptabilities.

While the permanence, fireproofness and rigidity of concrete floors are desirable qualities not open to question, the uncertainties concerning their use have centered around the possibilities of coldness, dampness, rough or displeasing surfaces, dusting and cracking. Therefore, what is stated about construction features, later in this article, will be largely with a view to offering methods by which these difficulties are avoided.

Those familiar with concrete residence floors have found many advantages probably not suspected by the average non-user. For example, the greater rigidity given to the structure eliminates vibration caused by heavy city traffic or children jumping on floors above. It also provides greater wall stability, a feature of importance in areas subject to earthquake shocks.

A large proportion of plaster cracks on both partitions and ceilings of dwellings is due to sagging or other movement of ordinary floors, exerting stresses in the backing which are transmitted to the plaster. Concrete floors do not deflect appreciably after the plaster is put on and therefore provide ideal support for both interior partitions and ceilings. Concrete floors seal out smoke and dust from the furnace room, odors from the kitchen, steam from the laundry and—I was going to say—noise from the nursery.

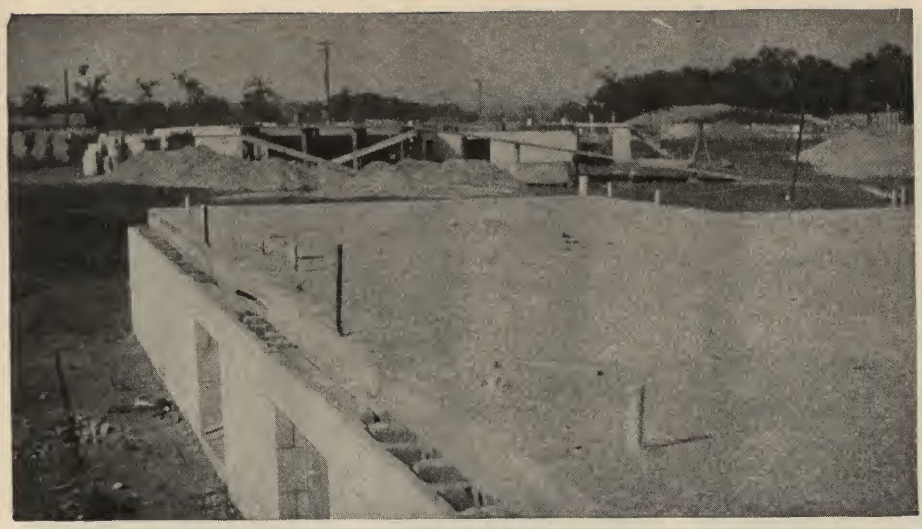
Concrete floors depend for their efficiency as sound deadeners largely on the fact that the smooth surfaces tend to reflect sound rather than pass it through the concrete, while coverings of the nature used on concrete residence floors tend to absorb sound.

Flat Slab Floors

Concrete floors are equally adaptable to dwellings having walls of solid brick, concrete masonry or monolithic concrete construction and the following description of building methods is applicable to structures of any of these types. Of the various methods evolved, the solid slab system is probably the simplest.

Reinforced concrete slabs of uniform thickness are carried

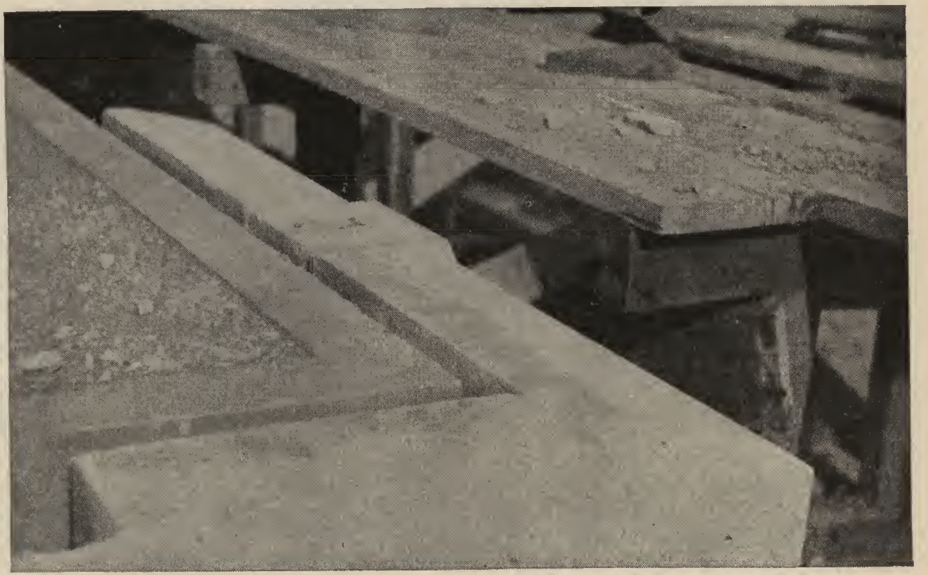
This Main Hall of a Concrete Floored Residence, Showing the Use of Black and White Italian Tile Flooring, Is an Excellent Evidence of the Fact That Concrete Floors May Be Made Beautiful as Well as Durable.



Concrete Floor Resting on a Concrete Masonry Wall. The flooring is covered with sand to insure proper curing.

across the room spans, and regardless of minor differences in slab thickness possible by reason of variation in span, the maximum thickness required for any span is usually carried throughout the entire width and length of the house. This obviates complications which might result if varying floor thicknesses were used in adjacent rooms. Of course this practice is subject to such variation as may be necessary to accommodate various surfacing methods employed in finishing up the floor in different rooms.

An accompanying table gives the necessary thickness of slab for spans or widths up to 16 feet, any length. Greater distances between supports is unusual in residence construction and requires a special design.

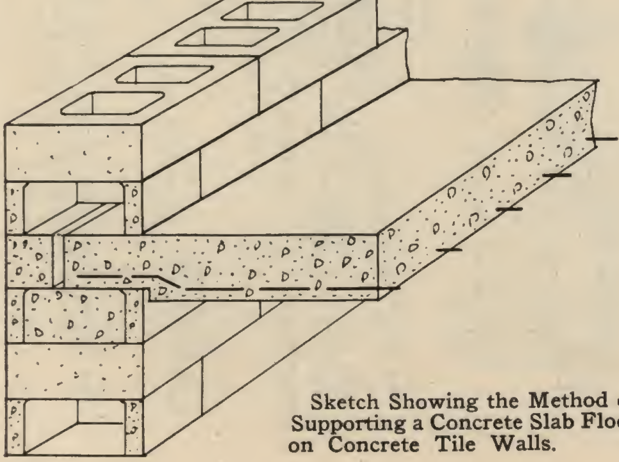


A Concrete Floor Built Up to Give It a Thickness Equal to That of the Water Table Course on the Outside. Notice the air space between the concrete floor and the masonry wall.

The diameter and spacing of round reinforcing bars for floor slabs is also shown in the table. For simplicity of construction the main reinforcing bars are made to extend only one way across each slab; that is, in the direction of the shorter span. Alternate bars are bent up near supporting points as shown in an accompanying sketch. All reinforcing bars must be fully as long as shown, in order to extend well over the supports. The cross or "temperature" reinforcing in all cases consists of ¼-inch round, or deformed bars, space 12 inches center to center, approximately 1¼ inches below the upper surface.

Ample bearing area on the walls is very important. Where the floor is to be carried on a 12-inch concrete block wall, as commonly used for basements, the slab should rest on the inner five inches of the wall, leaving room for a one-inch air space and four-inch veneer block or a single thickness of brick on the outer four inches of the wall. If resting on eight-inch concrete block or brick wall the slab is given the minimum bearing of four inches.

The floor slab never should be extended over the entire top of the wall, but always so laid that veneer block or brick may be used on the outside. To build floors at the desired levels without the use of fractional courses or "fillers" in the walls, the slabs are built up at the edges as required.

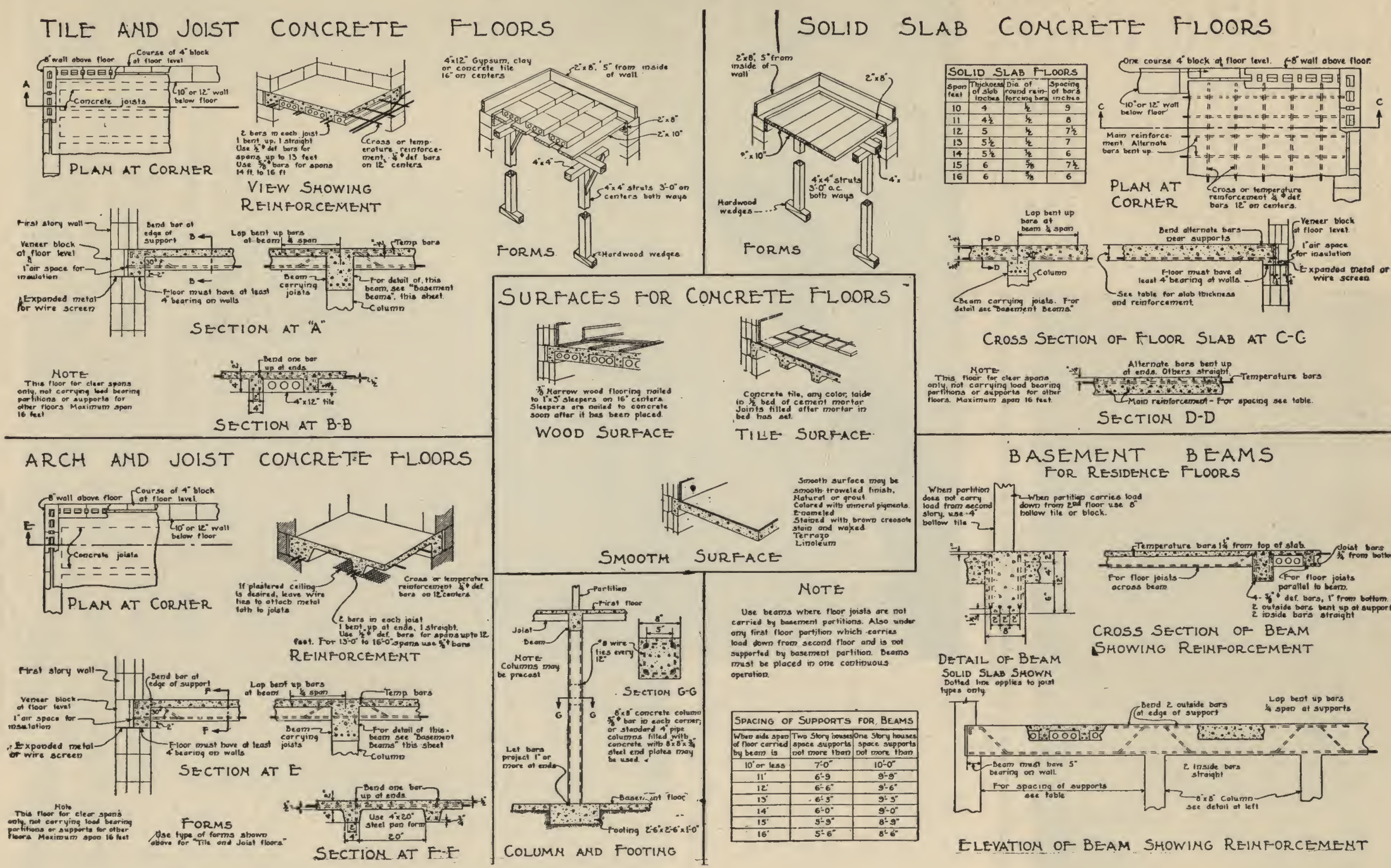


Sketch Showing the Method of Supporting a Concrete Slab Floor on Concrete Tile Walls.

The erection of forms for concrete slab floors is a simple matter. The forms usually consist of a false floor set on four by four-inch crosspieces which in turn are held up by four by four-inch posts placed three feet apart in both directions. Hardwood wedges are driven underneath these posts as required to level the floor forms. At moderate temperatures, the forms should remain in place for one to two weeks after the concrete is placed.

Beam and Slab Floors

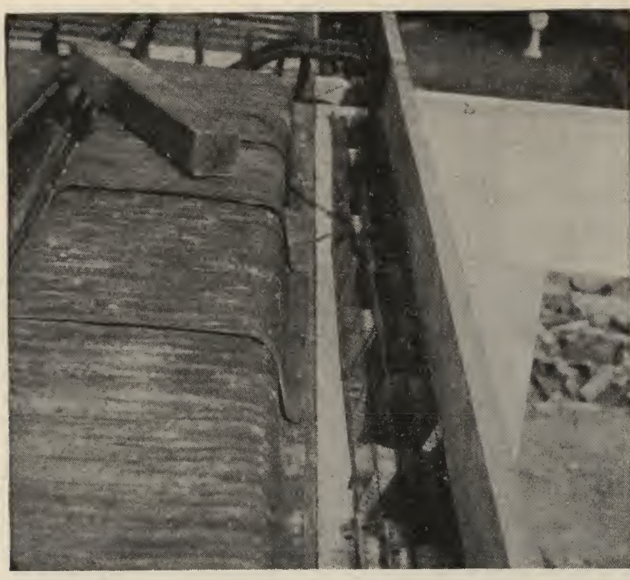
Beam and slab floors are generally considered slightly more economical of material but correspondingly more complicated to build. Consequently, where the floors for only a single house or a small number of houses are to be constructed the flat method (previously described) is used, while for more extensive operations the saving of material often gives preference to the beam and slab method. Two of the simpler types of beam and slab floors, specially adapted to the use of the smaller contracting organizations, will be described. The first of these two is commonly known is "beam and arch" or "steel pan" construction.



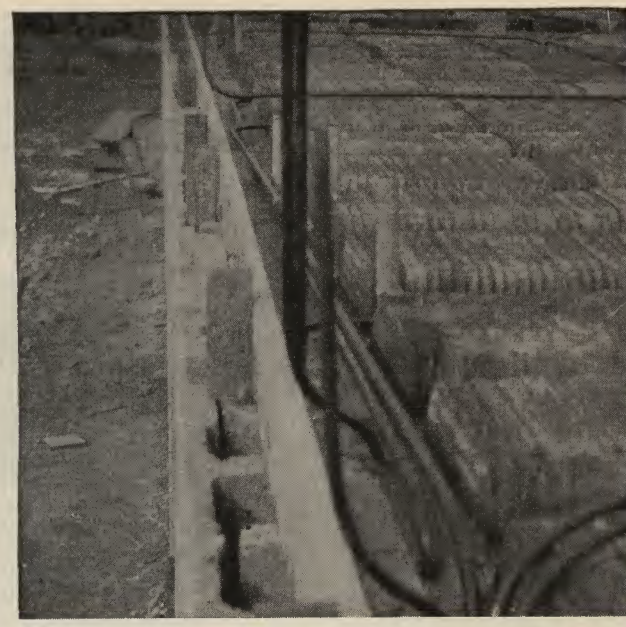
SOLID SLAB FLOORS			
Span feet	Thickness of slab inches	Dia. of round reinforcing bars	Spacing of bars inches
10	4	½	9
11	4½	½	8
12	5	½	7½
13	5½	½	7
14	5½	½	6
15	6	⅝	7½
16	6	⅝	6

SPACING OF SUPPORTS FOR BEAMS		
When side span of floor carried by beam is	Two Story houses space supports not more than	One Story houses space supports not more than
10' or less	7'-0"	10'-0"
11'	6'-9	9'-9"
12'	6'-6"	9'-6"
13'	6'-3"	9'-3"
14'	6'-0"	9'-0"
15'	5'-9"	8'-9"
16'	5'-6"	8'-6"

The Drawings Shown on This Page Are Largely Explained in the Captions Which Accompany Them and When Used in Connection with the Descriptive Matter in the Article Afford a Very Clear Idea of the Tile and Joist Floor, the Solid Slab Floor, the Arch and Joist Floor, Basement Beams and Surfaces for Concrete Floors.



Forms in Position for Casting a Tin-Pan Type Floor. Note the beam reinforcing and the metal lath used over the air spaces in walls to prevent the concrete from entering the latter.



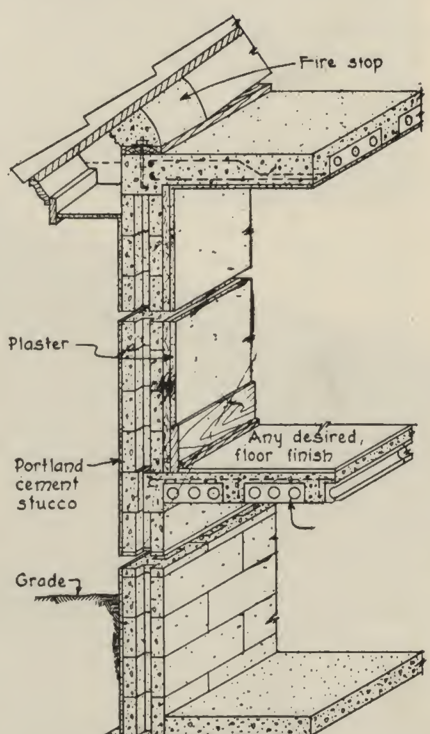
End Board and Floor Forms in Position for Casting the Beam and Arch Floor.

In constructing these floors inverted corrugated metal pans are used for forms. These are set with their edges upon planks laid flat and supported by posts below. Sufficient space is left between pans to form beams of requisite width. The beam reinforcement is laid in these spaces and as far as possible pipes and conduits are made to follow them. With good care these forms may be used over and over again. Careful handling and setting is necessary to avoid distortion of beam and slab dimensions and preserve the forms for repeated use.

Another type of beam and slab floor is constructed by what is frequently referred to as the "beam and tile" method. It is simpler in that cinder concrete or gypsum partition blocks take the place of the "tin pan" forms mentioned in connection with the previous method, the former remaining in place between the beams permanently, producing a smooth horizontal surface for ceiling plaster beneath.

This method makes possible a shallow beam and moderate total floor thickness, this dimension usually being six inches, several inches less than the thickness of ordinary wooden floors. Reducing the thickness of the floors gives several inches greater ceiling heights with the same wall heights, or makes possible any desired ceiling heights with a saving of several inches in wall height.

The reinforcing material for beam and tile floors is placed in the same manner as where the "tin pan" method is used and the support of these various types on the side walls is identical. The beam and tile method offers additional advantages such as affording easy passage for conduits or pipes which cannot follow the spaces left



Sectional View Showing Construction and Method of Supporting Concrete Beam and Tile Floor with Masonry Walls.

for the beams. Cinder concrete or gypsum tile may be cut as desired to permit laying conduits or pipes across them.

A convenient method of forming holes through concrete floors of any of these types, for the passage of heating and other vertical pipes, is by the use of galvanized iron sleeves. These tubes or sleeves are made of light material, with joint turned and rolled flat, with length usually three inches greater than the thickness of the concrete slab. The lower inch is slitted and bent down crow-foot fashion, for secure attachment to the forms. The tube is filled with sand to prevent collapse. After the floor has hardened the tube may be pried loose with a screw driver or left in place as desired.

Surface Treatment

Concrete floors for residences can never reach any great popularity until the variety of simple and beautiful surfacings is understood and appreciated. No one would choose for a fine house a concrete floor that would resemble a sidewalk. The residence floor requires more refined treatment. Happily, there are available finishes that are not only appropriate, but decorative and interesting as well.

For example, in many fine homes which have concrete floors throughout, fine oak flooring has been laid on strips over the concrete in the living room and library; the reception hall floor is covered with floor tile laid after the Italian manner, the dining room with Dutch tile and the sun room with smooth, waxed terrazzo. Baths and lavatories are floored with the usual small ceramic tile.

Kitchen and service halls have linoleum coverings cemented to the concrete.

How the Hurricane-Proof Demonstration Houses Are Built

Details of the Southern Pine Association Demonstration Homes at New Orleans and Miami, an Educational Campaign in the Interest of Good Construction

STORMS are rare—but unavoidable. Whenever they do occur they are frequently devastating. No section of the country can assert that it is absolutely free of them. Hence, when a man is building a home, he is obligated to its future occupants, whether they be his own family or strangers to whom he will sell the house when it is completed, to exercise reasonable and sufficient precaution against its destruction by high winds.

The Hurricane-Proof House as It Will Appear When Completed, at New Orleans, by the Southern Pine Association.

Considering these facts, the Southern Pine Association is educating builders along the lines of proper construction so that a form of tornado insurance may be built into the frame of the house while it is being constructed. This association has taken steps to erect two model hurricane-proof homes, one in New Orleans and another in Miami, so that the public may understand what precautionary measures are necessary to insure safety to the structure in the face of a destructive gale.

Incorporated in these homes are fifteen salient points of good construction, each plainly numbered and explained to all who visit the sites for a better understanding of hurricane-proofing. These fifteen details are designed to achieve rigidity in the structure by utilizing a combination of bracing and stiffening systems as perfected by Morgan D. E. Hite, architect for the Southern Pine Association.

Model constructors do not depend on sheer massiveness in order to give their buildings sufficient strength. Ancient carpentry, it is true, had to resort to hand-hewn and extra heavy timbers. But today the construction expert uses light weight materials which are easy to ship, which may be handled without great exertion and which are quickly assembled. However, despite this, it is not necessary for him to sacrifice strength and dependable rigidity in the finished structure—provided he understands the necessary principles which must be introduced into the framing.

It is just these principles which the Southern Pine Association is demonstrating to the public in its two model homes. Reduced to their essentials the fifteen salient points achieve three outstanding qualities:

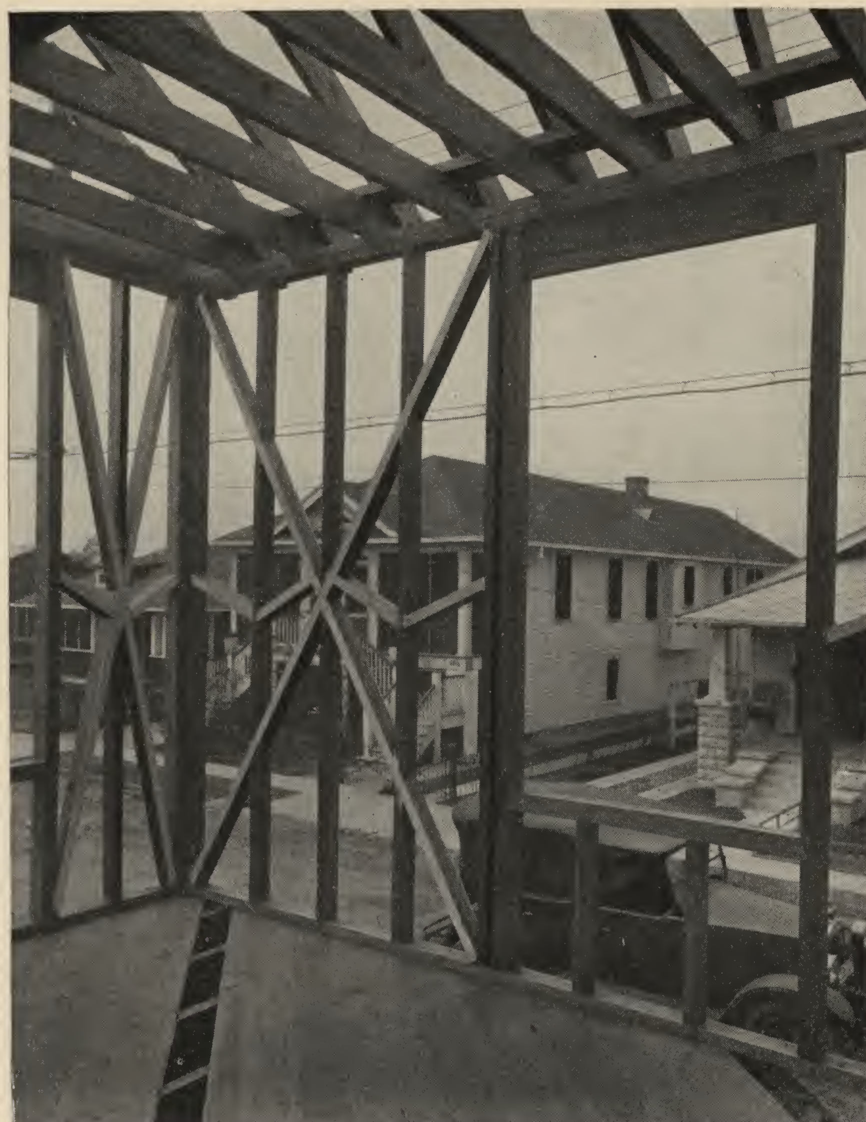
1. Economy in cost of materials and labor.

2. Rigidity of frame combined with the necessary flexibility to resist the effects of earthquakes, hurricanes, tornadoes, etc.

3. The requisite stiffness which keeps a building permanently straight, plumb and level, thus assuring its good appearance at all times. The result is a solid, substantial and compact building, easily kept up and always attractive.

The frame of the New Orleans model home is already

A General Exterior View of the Framework of the Hurricane-Proof House. The braces have been given one coat of paint to be seen plainly. The numbered signs on the frame correspond with the 15 points of good construction. There are two sets of these numbers scattered throughout the framework for the guidance of the public.



Note the Rafters Spiked to the Sides of Ceiling Joists in the Hurricane-Proof House. Also note the rafter heel plates on top of the ceiling joists, typical framing around the window, X-bracing in corners, herringbone bridging filling and open slots in the subfloor. The contractor carries proper public liability insurance during the demonstration period as protection against the possible injury of visitors.

completed and will be allowed to remain exposed for approximately two months so that the local public and visitors to the city may have sufficient opportunity to inspect it. In the first two weeks of the demonstration thousands of persons visited the site to examine the frame. Moreover, this exceptional record is still being maintained —offering, as it does, undeniable proof that the public is eager to learn good building principles.

Miami's model home is in the preliminary stages of construction. Others will probably follow in various parts of the country. As a matter of fact, Mr. Hite's services have been sought by a mid-western lumber association in order that the features of the New Orleans Southern Pine home may be duplicated in one of Michigan's leading cities. Thus, it is expected that the educational campaign will be far-reaching and that a high volume of good construction will result from the efforts expended by the Southern Pine Association.

The fifteen points of frame construction necessary to insure hurricane protection are listed below:

1. Solid sills—no built up sills—bolted down into the foundations, ¾-inch bolts, 8 to 10 feet apart. Proper joints.

2. Joists to rest on sills, well spiked down, not over 18-inch centers, cross bridged before sub-floor is put down.

3. Ends of joists tied at top with 2-inch material, running continuously. Sub-floor to be 1 by 6 square edge, shiplap, or tongue and grooved, laid 45 degrees diagonally, nailed with two nails to every bearing, every twelfth board omitted (for draining off rain water and for temporary wind vents) until roof is in place. Direction of sub-flooring reversed on alternate stories.

4. Bottom Plates of studding to be 2 by 4 or 3 by 4, single plate, well spiked to bearings.

5. Plate of studding to be doubled, joints lapped and joints over bearings. Alternated where partitions join outside walls, to make tie-in.

6. Studding:

For basement-raised type of house: 12-inch centers for basement, 16-inch centers for main story. Install cross partitions in raised basements.

For two-story house: 12-inch centers for first story, 16-inch centers for second story.

For cottage or bungalow: 16-inch centers.

Studding 2 by 4 for ordinary size homes, 2 by 6 for large homes or buildings with rooms of unusual size.

7. Bracing: Put in X-braces in all spaces between openings and at corners and in angles—where space permits. Fill in with studding properly spaced, and all drawn tight. For all outside walls, and for inside partitions only where needed.

8. Herringbone-bridging half way on stud height in all inside partitions, and to fill out in outside walls. Set at angle 10 or 15 degrees.

9. Stiffening over outside openings, especially wide openings, with wide 2 inch material, studs or cripples notched to same.

10. Truss over all wide inside openings with 2 by 4 material.

11. Stiffen doubled joists under heavy partitions with 2 by 4 or 2 by 6 spiked and bent onto sides of same. Leave opening between doubled joists where plumbing pipes and such work must come through, to avoid cutting and weakening these important parts of the house.

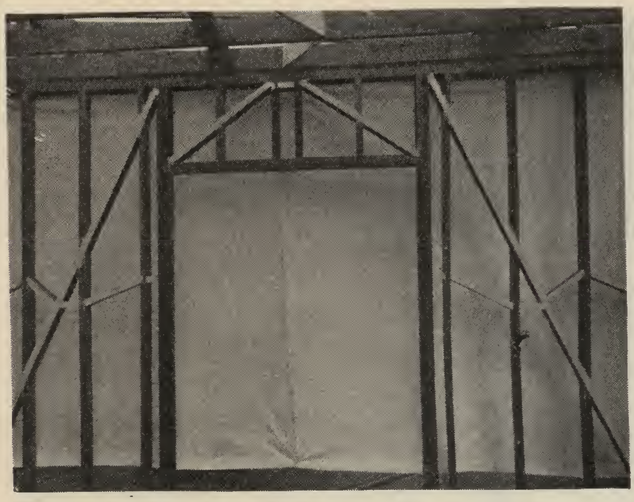
12. Inside partitions tied to outside walls and to other inner partitions by inserting ends into slot made of two studs spaced thickness of wall, blocked and spiked well.

13. Roof rafters collar braced (after roof sheathing is on), every other rafter, placed just above center line of height of attic space. Run angle struts to nearest bearing partitions to support roof and keep roof line straight, and necessary angle roof wind braces tied to ceiling joists and rafters. Rafters not more than 18-inch or 20-inch centers.

14. Sub-floor, or finish flooring, to be laid in attics of two-story houses, put down after rafter heel plates are laid.

15. Continuous, vertical ties for two-story houses, running on angle from roof line to bottom sill, 1 by 6 stock notched into outside face of studding (not necessary if house is storm-sheathed).

Use all necessary nails and spikes of proper size. For permanently exposed work such as pergolas, arbors, etc., used galvanized nails.



An Interior Partition of the Hurricane-Proof House, with a Wide Opening Framed for Double Doors. Such openings tend to weaken the resistance of partitions to stress and to crumple, buckle, etc., especially if the doors fail to hold. This house is made safe by being so designed that each room is a unit or cell that is air-holding, whose walls, partitions and ceiling will not collapse, buckle or careen to allow wind to tear its way through the rest of the house. This opening will not give way, its weakening tendency being offset by bracing.

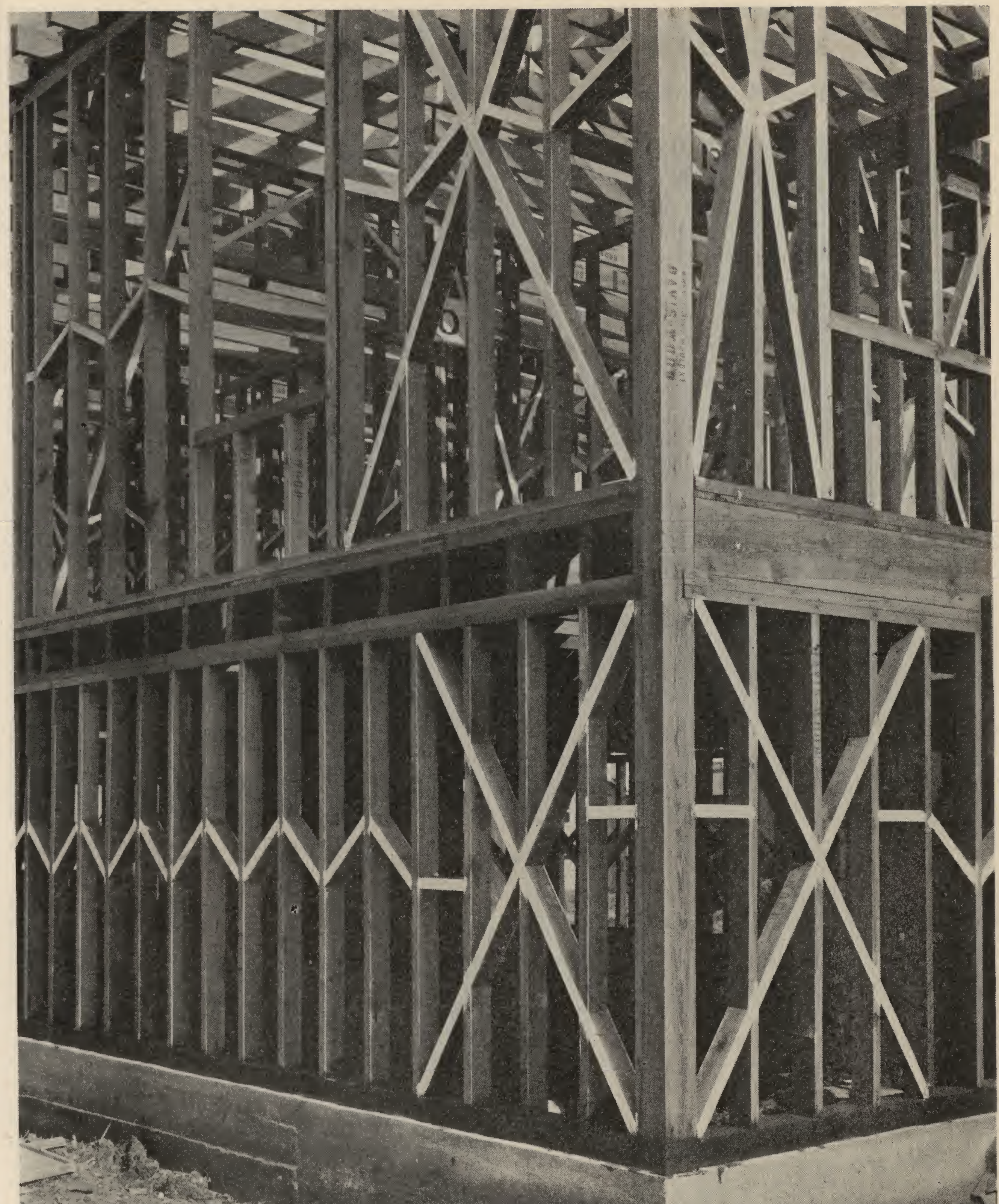
The Southern Pine Association explains that storm sheathing is not necessary to withstand hurricanes but it is always advisable. On the other hand, it is quite necessary if the house is to be subjected to storms of cyclonic intensity. In all cases, whether or not storm sheathing is used, the studding and framework should be protected with heavy, asphalt-saturated felt, not lighter than 30 pounds per 100 square feet. This felt should be placed between the frame and the stucco, weather-boarding, shingle siding or brick veneer exterior finish.

As the expense of such protective measures is always an important detail in the builder's budget, it might be well to touch upon this angle before concluding. The New Orleans model home, when completed, would cost the builder approximately $10,000. It is a raised-basement, bungalow type of dwelling, with eight rooms and two baths on the main story. The basement will be utilized for service, garages, heating plant, laundry room and storage room. Yet, the materials for hurricane-proofing the house cost only $45; and the labor amounted to only $40. In other words, both labor and materials reached a total of less than 1 per cent of the entire expense of construction.

These small additional expenditures cannot be considered as an unredeemable loss. In addition to the protection they offer to occupants of the house they provide other compensations. A movement is on foot to induce insurance companies to recognize their importance in tornado insurance policies. The year of 1926 has been a disastrous one for many companies in the field of tornado insurance. As a result, the advisability of raising such rates has been seriously discussed with the possibility—nay, probability—of these raises becoming effective in the early part of 1927.

But it is expected that a hurricane-proof house, of the type being demonstrated by the Southern Pine Association in New Orleans, will be recognized as being superior to the average unprotected home. Once this is done, the insurance people cannot help but allow it preferred rates for tornado coverage. Hence, the slight additional cost during construction will accrue benefits for the builder that will more than amortize the original expense within a short time.

General Interior View. The thickly clustered studs usually indicate where a partition or wall joins another, forming a vertical slot into which the walls, or partitions, fit and are blocked and spiked into position. Tying of walls to partitions and partitions to one another, is one of the urgent requirements for safety under powerful hammering and twisting storm stress.



A Detailed View of a Front Corner of the Hurricane-Proof House Showing the Corner Posts Running the Full Height of Both Stories. The alternative method of having short corner posts on each story the same length as the studding instead of the continuous length is also recommended. No special sizes or grades are required for this system of framing but the regular run of lumber available in lumber yards was used. The grades chosen were No. 1 Comm. T & G, one by six, for subflooring. Sills, if not creosoted, should be 85 per cent heart.

Textured Interior Walls

So-Called "Rough Wall" an Established and Individual Surface Finish

By Means of Textured Wall Surfaces, the Living Room of the Good Housekeeping Studio Was Made over Into a Model of Italian-Spanish with an Ease Which Was a Constant Source of Surprise to the Owners.

THE demand for textured interior wall surfaces has come to stay. Rough walls, as they are rather erroneously called, with their vast possibilities for variety in finish, have taken the place of the more commonplace style of treatment so long in vogue. There is no need here to go into a discussion of the wide field thus opened to painters and decorators, both amateur and professional. Suffice it that when a person knows he can have a room of beauty and distinction, one which gives him a sense of personal pride in ownership, he won't be satisfied with anything less. The preliminary work of introduction is over. The demand for the textured wall will not be denied. The chief question now is how best to get results.

Up to the final perfection of the original material developed for obtaining the texture wall, there had been many ways of approaching the defects. Many painters still make up a combination of calcimine, whiting, glue, etc., which sometimes gives fairly good results, but often comes peeling off the walls when proportions have not been accurately estimated or the surface to be treated happens to be not quite right. Uneven and very limited effects may also be obtained with a lead and oil combination which is ridiculously costly in comparison with the results so laboriously obtained.

And there are other attempts to meet the demand, materials which will work here and not there, mixtures which will set up in the pail if the painter happens to meet with unavoidable delays, and so on ad infinitum. What the builder wants is a material which will always stick to the given surface, which will not set up in the pail, which will give him time to work with it on the walls or ceilings, in short, a prepared material chemically perfected to assure success to the man who uses it.

Such a material is now obtainable. Time is the only real test for any product which must meet the battle of daily life and ten years of service is none too much to furnish actual proof of values. When it can be demonstrated that a textured wall applied fifteen years ago with a given material is still in good condition most questions are answered. When this instance can be multiplied many times under many different conditions there doesn't seem to be much room for doubt.

"But all your finishes are imitations!" one frequently hears. "You imitate Travertine Marble, Caen Stone, the different European plasters, etc., etc., but it's all imitation." Except for decided inaccuracy in the statement the point is rather well taken.

In the beginning the only way to convince people of the value of the new medium was to copy the beautiful wall treatments of the past. The seal of antiquity is the usual stamp of approval on all things new from the design of clothes to the design of buildings and this has been true

Textured Surfaces Served to Make This Display Room of a New York Furniture Company an Ideal Place for the Display of Fine Furniture.

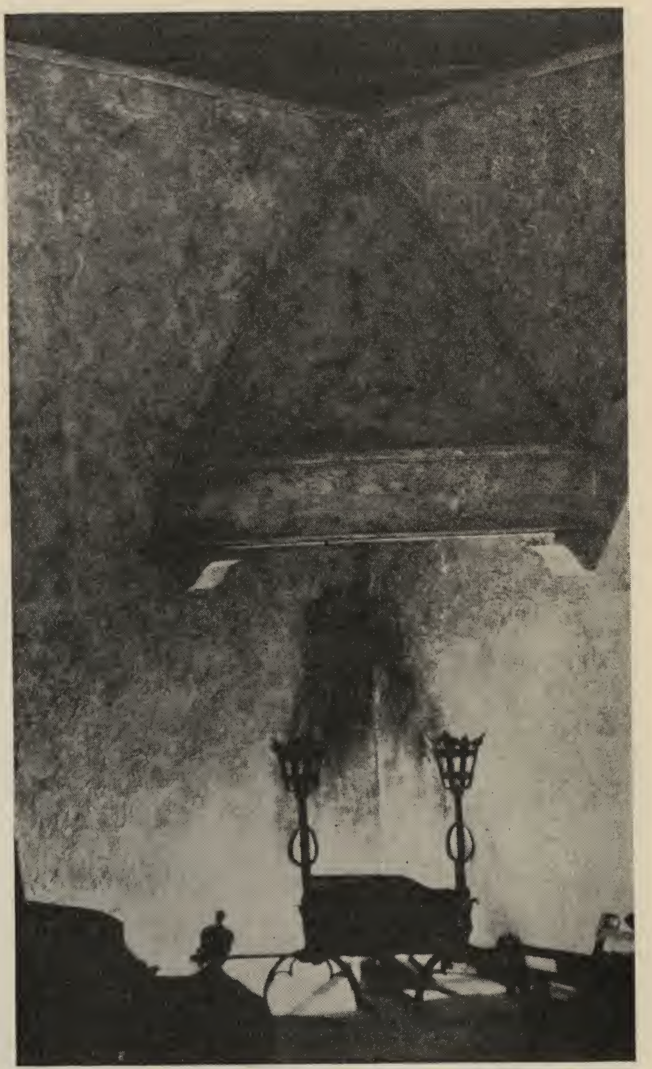
of the textured wall surface. But now the tide is turning. Open minded people are coming to see that sheer beauty and harmony are quite as possible of accomplishment in a product fifteen years old provided it is a suitable and reliable one as in a material fifteen hundred years old.

Finishes have recently been made which are in no sense imitative but which bear all the appearance and authority of antiquity. These finishes are not such and such a plaster imitation or such and such a stone imitation but stand on their own merits as distinct and individual creations of an inherently beautiful medium. To carry this line of thought a little farther it is only necessary to mention the comparatively recent relief work which is beginning to make American mural decoration something absolutely unique in the history of that great art. The ease with which designs may be carried out in bold relief is a source of delighted wonder to experienced artists in this field.

Most interesting also to the particular builder is the fact that textured walls are by no means exclusively meant for the rich man. If such were the case the demand would hardly be sufficient to warrant the production on a national scale of a material suitable for the purpose. The product must be as universal as paint, fit for carrying out the most artistic conceptions in mural decoration and adapted also for use in the most inexpensive of cottages where the demand for beauty and permanency must be reconciled to the limitations of a thin purse. Sometimes it is a money-saver in actual dollars and cents when used over one or two coats of floated rough plaster or over one of the rigid, gypsum centered wallboards without paneling.

Think of building a big summer hotel without using a pound of plaster! Think of redecorating a renovated farmhouse with its old, cracked plaster walls by one day's work with a brush! Think of making over your living room into a model of the Italian-Spanish type as was recently done in the Good Housekeeping studio with an ease which was a constant source of surprise to the editors of the magazine! Think of altering an office in one of New York's commercial skyscrapers into a studio with this material on walls, ceiling and even on the floor in an imitation of stone! Think of a material so universal in its uses that it will stick to paint, paper, wood, metal and even glass!

In the Congregation B'Nai Jershurum, in New York City, Textured Walls Were Used in Producing the Elaborate Decorations Shown Here.



In One Corner of the Good Housekeeping Studio This Unusual and Attractive Fireplace Was Possible Through the Use of This Method of Surfacing.

N. Y. Trade Schools Popular

THE Apprentice Commission of the New York Building Congress reports that there are 2,240 apprentices enrolled in the building trades schools of that city at the present time, representing seven of the building trades.

Hand Forged Colonial Hardware

By MYRON S. TELLER

IT would take an article of considerable length to describe the various changes of style in our Colonial hardware from 1650 to 1850 covering the hand forged iron work, the handles and latches mounted on plates, spring latches with knobs and lever handles, the iron and brass rim locks and the first types of mortise latches, where the object was to hide the hardware. I have chosen to deal with the first, the hand forged iron work made on the anvil by the blacksmith. This is the earliest form of hardware used in our Colonial days and naturally we find it mingled with the other styles that followed.

Examples of the earlier and more primitive style of Colonial houses are fast disappearing and it is to be regretted that in the material or references available to the students of architecture and other interested persons so little information is to be found pertaining to this old style hardware and its application. Perhaps this is due to its simplicity, for there are but few rules. These, once they are understood, may be easily adapted to the modern construction of frames and doors expressing the same quaint touch and giving good services as did the old.

The hardware fitments for the house were not of first importance in the Colonial blacksmith's trade, yet the workmanship and finish on old examples of hardware and household utensils is evidence of his pleasure in showing his skill in this branch of his craft. His ingenuity in fashioning a hinge from an old worn tire iron and the forging of other odd pieces into a variety of household articles are interesting proof of that skill.

Fig. 1. A Typical Old Colonial House Which Was Recently Restored. It is equipped throughout with hand forged hardware, wherever pieces of the original hardware were missing, new pieces were made to match perfectly.

Fig. 2. Hall in an Old, Stone Colonial House in Ulster County, N. Y. Here is a fine example of the Colonial stairway, wide board flooring and heavy beamed ceiling. The top section of the Dutch door is open, showing the drop handle, while the lower half shows the inside latch and strap hinges. The door under the stairs shows the use of H-L hinges.

Fig. 3. This Door Is Fitted with a Latch with the Handle on the Outside. The small plate above covers a modern key cylinder. Strap hinges and lag pins can be seen on the shutters. Long iron hooks fastened to the sills hold the shutters open. Mud scrapers are formed in the iron hand rail at the bottom step on each side.

For those who may not be so intimately acquainted with the style of Colonial house in which this iron work was used, it may be of interest to give a description of these houses. Some are still to be found in the early settled towns and villages and occasionally we come on others in unexpected places. In some sections stone was used largely; in others they were mostly of frame and again we find localities with both stone and frame houses. They were more often built one and a half stories high.

The wooden buildings were framed of heavy timbers, mortised and tenoned and fastened together with wood pins; little iron was used in this part of the work. The window and door frames were solid oak, also framed together at the corners and fastened with wooden pins. Even the floor boards were often pinned down with wooden pegs.

Interior views of such houses are shown in Figs. 1 and 2. Here we find the painted floors of wide hand-planed boards of varying widths. The ceilings are low, often not over seven feet high, the boards of the floor above forming the ceiling for the room below. These boards are supported on heavy hand-hewn timbers, spaced four or five feet apart, the ends resting in the stone wall or if in a frame house, on the wood girt which often projected beyond the plaster of the side walls. If the house was of stone, the ends of several beams would be anchored through the wall with an iron of quaint design showing outside. Some times these anchors were in the form of numbers recording the date of building as in Fig. 6 of wall irons.

The fireplaces in these houses were an important feature, especially those in the kitchens. They were built wide and deep, arched high with a brick or a wood lintel over the opening. Fire wood was plentiful and easy to obtain and no doubt this was one reason for their being built of more generous dimensions than most of the fireplaces in the old country. The kitchen fireplaces often had ovens built in at one side and huge smoke chambers. Some of the smoke chambers were reached from the floor above through an opening built in the chimney and here, on cross poles laid in the chimney walls, the hams and bacons were hung to cure.

A cross pole of wood or iron supported the large trammel irons to which the smaller pot hooks were hung, to hold the pots and kettles. Other fireplaces had iron cranes to hang the pots and swing them over the fire.

In such surroundings the hand-forged hardware found a companionable setting.

The doors, shutters and cupboards in the early Colonial work were fitted flush with their frames, that is, the face of doors or shutters, and at least two to three inches of the frame were on the same plane so that the strap of hinge and bar of latch and bolt could apply flat against this surface and lap over the joint between the door and frame without requiring a bend or offset that would be more difficult and exacting to fit.

Figs. 13 and 15 illustrate this, which is perhaps the most important detail to consider in using the Colonial hardware, in fact for all types of hand-forged hardware which applies to the surface of doors and frames. There were exceptional cases where the hardware was made with offset to meet special conditions, but in dealing with this I shall describe and illustrate the more usual way I have found these applied.

The first doors and shutters used were made of hand-sawed and planed boards fastened to cross battens with hand-made nails. They were hung on strap hinges which were also fastened to the boards and batten with nails clinched on the opposite side. The hinge rested over the hinge pin or gudgeon, the spike of which was driven into the heavy frame of the door or window made of solid timber as before described.

The door or shutter was set in a rabbet cut in the frame so as to finish flush with the frame or casing and the

Fig. 4. A Batten Door in the Old Van Buren House, Kingston, N. Y., Showing the Use of Strap Hinges and Latch.

Fig. 5. Typical, Six-Panel, Colonial Butt and Bead Door with H-L Hinges and Latch. This door is paneled on one side only.

Fig. 6. Chimney or Wall Anchors, the One at the Left Was Used to Form the Figure One of the Date 1620 When the Building Was Erected.

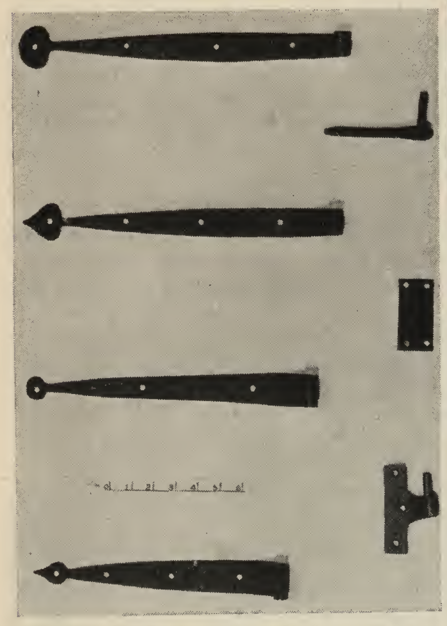


Fig. 7. Strap Hinges and Three Types of Hinge Pins, from Top Down: First, a Lag Pin or Gudgeon; Second, Hinge Pin Mounted on Plate; Third, Pin with Plate to Mortise Into Jamb at Edge of Door.

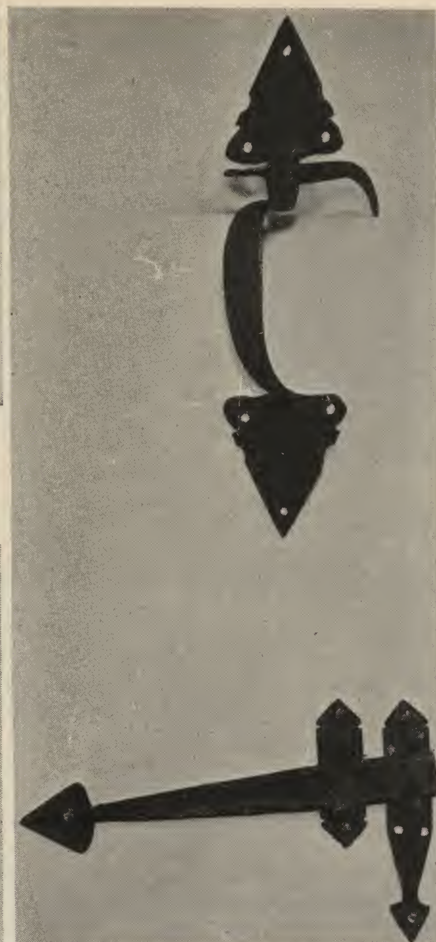


Fig. 8. Reproductions of an Old Pattern, Top Thumb Latch Handle with Pine Tree Design, Bottom—Latch Bar with Keeper and Guide Mounted on Plate. The latch bar was usually set with a slope or cant which made it ride more easily over the nose of the catch pin.

Fig. 9. Reproductions of Mud Scrapers from Old Patterns. These have holes for nailing to the step while others were designed to set into masonry.

Fig. 10. Adaptation of Old Door Latch Handles to Assemble with and Operate a Modern Cylinder Front Door Latch. The top of the outside handles forms the escutcheon for the key cylinder.

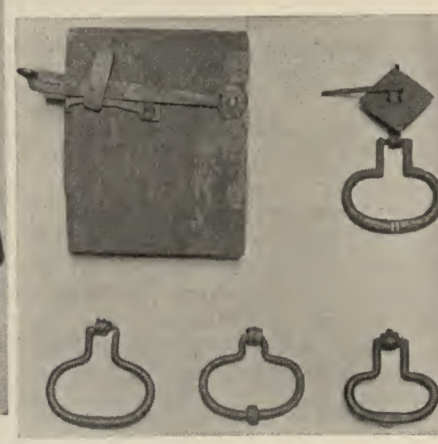


Fig. 11. Types of Old Dutch Door Latches and the Assembly of the inside latch.

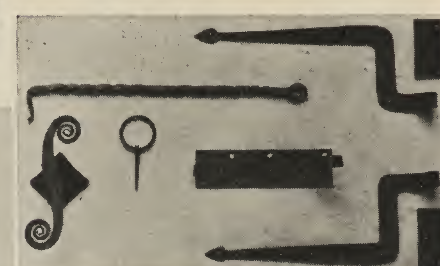


Fig. 12. Shutter Hardware, Angle Hinges, a Hold Back, Hook, Pull Ring and Slide Bolt.

hinges and latch were applied to the swing side. Fig. 4 is an example of the typical Colonial batten door and its hardware. On these the strap hinge was used largely and is best suited as it helps to reinforce the battens in holding the boards together. The strap hinge was used to some extent on paneled doors, especially outside doors and shutters. Fig. 3 illustrates this. Fig. 7 shows a variety of strap hinges and three types of hinge pins of which the spike pin is the older and best form. The pin mounted on the plate is a form which screws to the surface of the frame. The other, a mortise pin, was not so commonly used.

Fig. 13 shows a modern adaptation of old style hardware, strap hinges and latch, while Fig. 15 shows the details for applying the hardware to doors and windows.

On the inside paneled doors the H and H L hinges were used as in Fig. 5. On outside paneled doors angle straps were used as well as the straight strap, as can be seen in Figs. 1 and 2. H and H L hinges of various forms were used on the doors of cupboards.

The latch with a thumb lift handle was the most common type used—on the inside doors of which the earliest form had a latch with staple guide and spike catch pin, as shown in Figs. 4, 5, and 15.

Figure 8 shows the design of the door handle and latch while Fig. 10 shows thumb latch handles adapted to operate a modern mortise front.

On the entrance door today it is desirable to have an easy means for locking and unlocking from the outside of the door, and this may be done in two ways: the first and best is to use the old style latch and handle and above this provide a mortise cylinder lock with dead or spring bolt operated from the outside by a key and inside by a turn knob, the key cylinder to be fitted with a

hand-wrought iron escutcheon plate outside and a wrought iron thumb turn inside. In this way the modern hardware is inconspicuous as in Fig. 3.

Another way is to use a mortise cylinder front door lock with a latch trip to be operated with a wrought iron thumb lift handle on each side. The cylinder and turn knobs can be applied as in the other case, or the ends of the handles may be fashioned to provide an escutcheon for the key cylinder as in Fig. 10.

Another type of latch was operated by a drop handle of which Fig. 11 is an example. These are usually found on the Dutch door which is built in two halves and fitted with one of these drop handles near lower edge of the upper half. A spindle looped over the handle passed through the door and at the end of spindle a cam was fitted to lie under the bar of the latch, one end resting in the latch guide. A twist of the handle raised the latch and disengaged it from the catch pin. After the upper half was opened, one could reach over and lift the latch of the lower door from the inside.

A typical example of such a door with the original hardware as applied can be seen in Fig. 2. The bolts for these were made of a round bar of iron with a handle fashioned in the middle. Two loop staples held this to the door and a third keeper staple was driven into the log frame. (This style of bolt may be made with loops to nail or screw against the face of door if desired.) Little hardware showed on the outside of these doors other than the drop handle which also served as a knocker.

At one side of the doorstep a mud scraper was set in the stone or fastened to the wood steps, sometimes one at each side, a reminder for those who entered to scrape their muddy boots. Fig. 9 shows two designs.

The shutter hardware is found equally interesting. Hinges were of much the same shape as used on doors and hung in the same manner on iron pins or thumbs driven into the solid frames. We also find the hinge pins used, mounted on a plate. Angle hinges are often found on paneled shutters.

Fig. 14. Fireplace with Utensils of Wrought Iron Including Skillet Hanging at the Side, Crane with Pot Hooks Holding the Kettle, Fire Tongs and Andirons.

The shutters were fastened with a small hook to a pin driven in the sill and locked together with a wood bar dropped in irons; later slide bolts were used and a ring pull was placed on the shutter that swung in last. Long hooks held the shutters open. These were fastened to the shutters or sill, see Figs. 3 and 12.

No doubt the fireplace afforded the greatest outlet for the craftsman to display his skill in fashioning the pot hooks, trammel irons, cranes, oven doors, fire dogs, pipe and fire tongs, trivets and toasters and many of the cooking utensils such as forks, ladles, skewer sets, skimmers, skillets, griddles. Examples of these express a delicate sense of proportion in their design and exquisite finish.

Fig. 13. Here Is a Modern Adaptation of the Hand Forged Iron Strap Hinges, Latch and Bolt, Used on the Entrance of a Cottage at Woodstock, N. Y.

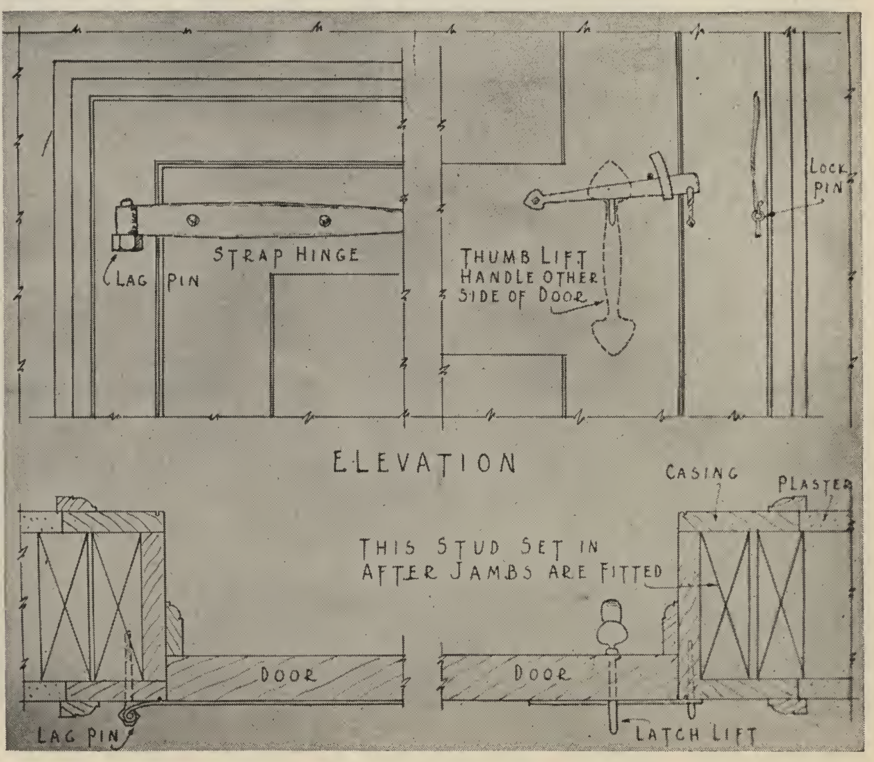


Fig. 15. This Drawing Shows the Details for the Application of Colonial Hardware to Doors and Windows.

The Influence of Elaborate Stage Settings as Constantly Presented in the Movies Is Having a Marked Effect on American Home Decoration. This glimpse of a Brooklyn apartment interior with its wrought iron gates and exactitude of period furnishings suggests indeed a "Castle in Spain."

Period Design in Residential Electric Fixtures

IN early colonial days our forefathers illuminated their homes with candlelight and rush light. There were imported from the old country designs contemporaneous with Sheraton, Hepplewhite and Adam for the beautifully simple sconce, candelabra and candlestick, to carry the hand-poured candle. In and near New York the Dutch and Flemish influence was common and in the South many examples of the beautiful French crystal work were to be found.

With the development of the whaling industry came lamps and chandeliers utilizing sperm oil as an illuminating agent. In these the early Colonial simplicity persisted.

So existed the first period types of lighting fixtures in America. There followed the advent of "coal oil" and illuminating gas and the final adoption and extended use of electricity, the most efficient method of lighting so far discovered.

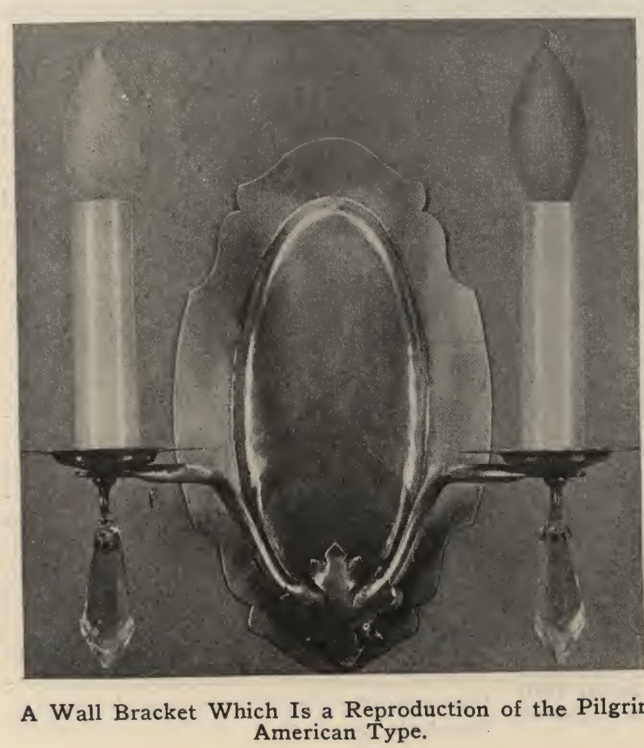
A Ceiling Fixture of the Spanish Type, Appropriate for the Modern Home Where Low Ceilings Have Replaced the High Ones of the Days of Gas Lighting.

Purely mechanical in treatment, a product as well of the heavily decorated Victorian age, neither the coal oil fixtures nor the gas fixtures gave us anything in the way of real beauty in home lighting. Early electric fixtures followed the old familiar cross arm design employed in gas lighting and the few service brackets used were of the "stiff arm" variety. A lighting fixture was all that could be desired providing it satisfactorily held that new mechanical wonder—the electric bulb. Those of us who were brought up on oil lighting or even gas lighting were charmed with the splendor of the new dazzling light, ready at a touch of the finger. The fixture that held the bulb was of little consequence for the light itself satisfied completely. This attitude is found even today in country districts where the long arms of the power companies are just reaching. It is not an uncommon experience to find 100-watt lamps, unshaded, suspended before the squinting eyes of a prosperous, back country farm family.

However, since the conduct of electricity through a wire did not present such mechanical difficulties as that of gas through a non-leakable metal tube, there rapidly came to the fore in electrical fixtures, scroll arms, flower effects and what not. Metal was tortured in every conceivable shape by prolific designers seeking ever to find the popular number that would sell. Showers, stove-leg arm effects, pan types, all ran riot, and whatever was the thing was manufactured and sold.

True, we were dealing with a new force in lighting and it is charitable to assume that designers were trying to express the spirit of electricity, to give the new energy an artistry all its own.

In recent years American women have been developing



A Wall Bracket Which Is a Reproduction of the Pilgrim American Type.

Another Wall Bracket Is of the English Style Which Is Now So Popular.

Most Beautiful and Practical Effects Can Be Achieved by the Proper Selection of Lighting Fixtures Made in Period Design to Harmonize with the Style of the Home and Its Furnishings.

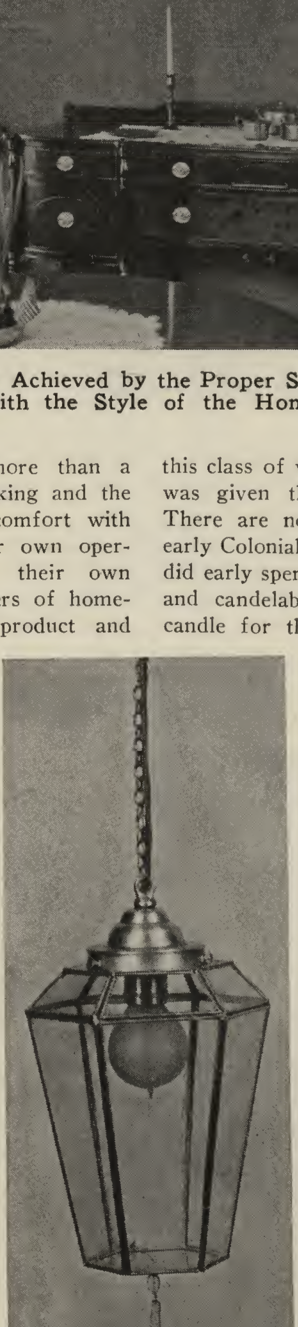
the home to the point where it is much more than a roof and four walls devoted to the art of cooking and the raising of babies. Comfort, and, above all, comfort with beauty, is demanded and insisted upon. Their own operations and investigations conducted through their own clubs and magazines, literally forced all designers of home-making materials to take account of their product and reconsider its design.

Furniture manufacturers gave up trying to design a typically American period and copies of old Sheraton work, Adam effects and Hepplewhite charm became predominant. Old lines from the old masters, beauty that had lived through the centuries, was substituted for designs made to sell. Rugs, draperies, wall coverings and architectural designs for the exterior jumped back to the old permanently beautiful period lines.

It is well to note that it was not merely that the talking of "period effects" had become a fad, but rather an admission that in home building we had not been able to create a new beauty to supersede the old. The old, preserved in line and reproduced to meet modern conditions, was our only source of real satisfaction for the new American home-maker.

In the lighting fixtures this demand came first from large public buildings where an expert schooled in the complete job wished to carry out a period scheme of interior decoration. Of necessity the fixtures had to harmonize. Soon the larger and more pretentious homes, treated by expert interior decorators, called in fixture designers to manufacture special fixtures suited to each individual room treatment, giving at the same time sufficient illumination. Busy on this class of work, it was not until recently that any attention was given the lighting equipment for the average home. There are now available, however, candle effects after our early Colonial lighting that copy closely the wax taper. Splendid early sperm oil designs have also been preserved. Sconces and candelabras have been copied substituting the electric candle for the flickering candle flame, old fire screen outlines and chair back outlines of Sheraton have been used to produce delightful brackets. The line and leaf from old Colonial urns have been successfully carried through a series of modern numbers. The solidity and massiveness of the Flemish has been woven into a number of available home lighting units. The beautiful crystal work of Marie Antoinette's time is easily adapted and the old Italian and Spanish metal work give us a new note of striking beauty. Period line in all its charm has come again to the American home in its lighting equipment. Due to American ingenuity in mechanical details, to American production and distribution methods, such design imposes no additional cost over the old ornate quality group of lighting fixtures. A few of the more prominent manufacturers of fixtures for average American homes have become distinguished for special application of the period idea. These have specialized on period designs in hammered and hand-wrought effects and have applied Sheraton line to an excellent group of designs, manufactured a number of excellent sperm oil reproductions and unusual old lantern effects.

There is available then for the home-maker a period type fixture that will harmonize with the furniture, rugs and draperies already in place.



The Colonial Lantern Is Very Effective in the Hall of the Modern Colonial Home.

ELECTRIC WIRING AND EQUIPMENT

Adequate Today, But Inadequate Tomorrow

Our Growing Needs in Electrical Matters

PROBABLY in no other branch of construction do ideas of adequacy change as rapidly as they do in relation to electricity. This is particularly true of ideas relating to the wiring requirements in residential buildings whether these buildings be detached homes, apartment houses, apartment hotels or hotels.

Yesterday it was enough to provide light. Today scientifically distributed illumination, free from glare, and flexibly controlled by conveniently placed switches is the common desire. Where before the lamp socket was considered sufficient to accommodate the few appliances used, several convenience outlets are now necessary for the accommodation of the innumerable portable lamps, motor driven devices and heating appliances in every day use.

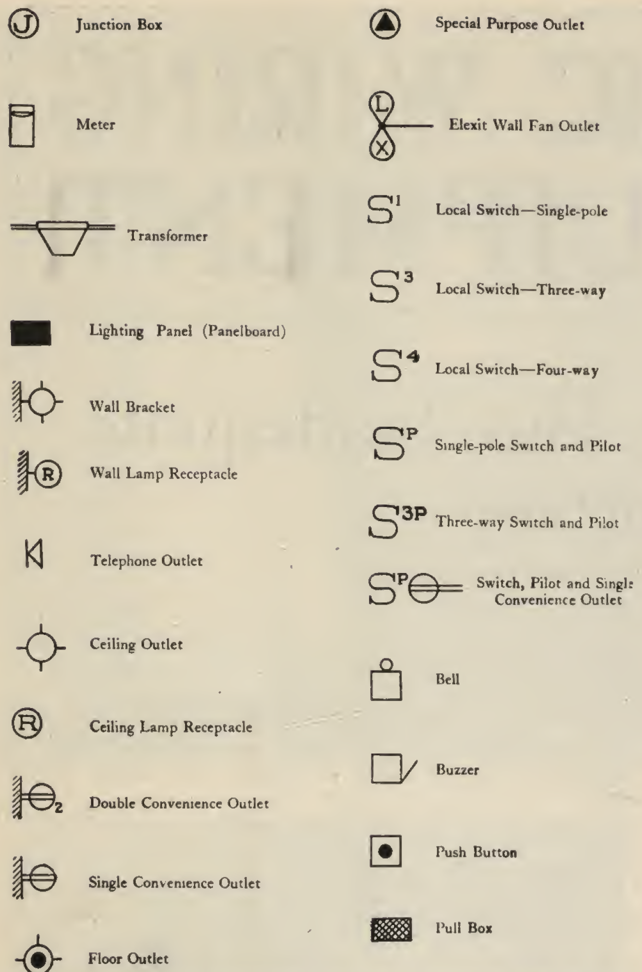
What the requirements will be five years hence are almost impossible to forecast but one thing we may be sure—the conception of adequacy as evidenced in the average residential building being constructed today will be hopelessly inadequate within a short space of time. Casual observation of the common uses of ugly multiple socket devices and the accompanying network of unsightly surface wires will confirm this.

Considerable study has been given to the past and present applications of electricity in residential buildings and attempts have been made to visualize the wiring require-

Breakfast Nook Showing Suitable Location for Convenience Outlet.

Bedroom Showing Ceiling and Wall Light Outlets and Convenience Outlets. The latter are generally located in the baseboard; however, in many sections the higher location is preferred.

Bathroom Showing Location of Convenience Outlet and Mirror Lights



Symbols Used on Building Plans to Indicate Features of the Electrical Service Installation.

ments of the immediate future. As a result of this study certain specific recommendations both as to adequacy and quality have been evolved.

These recommendations are intended as a guide to builders who take a professional pride in anticipating future tendencies in the construction field. In recommending to these builders that they revise their present conception of adequate wiring to accord, in general, with these recommendations, the incidental commercial advances have been subordinated to the immeasurable advantages of complete and permanent wiring to future occupants of residential buildings now contemplated.

Because of the diversity of entrance requirements in the larger multiple residence buildings, it is obviously difficult to treat them as specifically and completely as detached dwellings but insofar as the actual wiring requirements of the living quarters are concerned, there is but little distinction.

An initial recommendation is that minimum of 3 per cent of the total estimated cost of the building be budgeted for the wiring (exclusive of lighting equipment). Experience has indicated that this figure represents the minimum necessary to insure an adequate installation composed of quality materials. As a matter of fact builders would undoubtedly secure the highest value for their dollar if, at the outset, they informed electrical contractors that a sum equivalent to 3 per cent of the total estimated value of the building had been set aside for the wiring; and awarded the contract to the electrical contractor who offered to provide the most complete service and the most dependable materials for that amount of money.

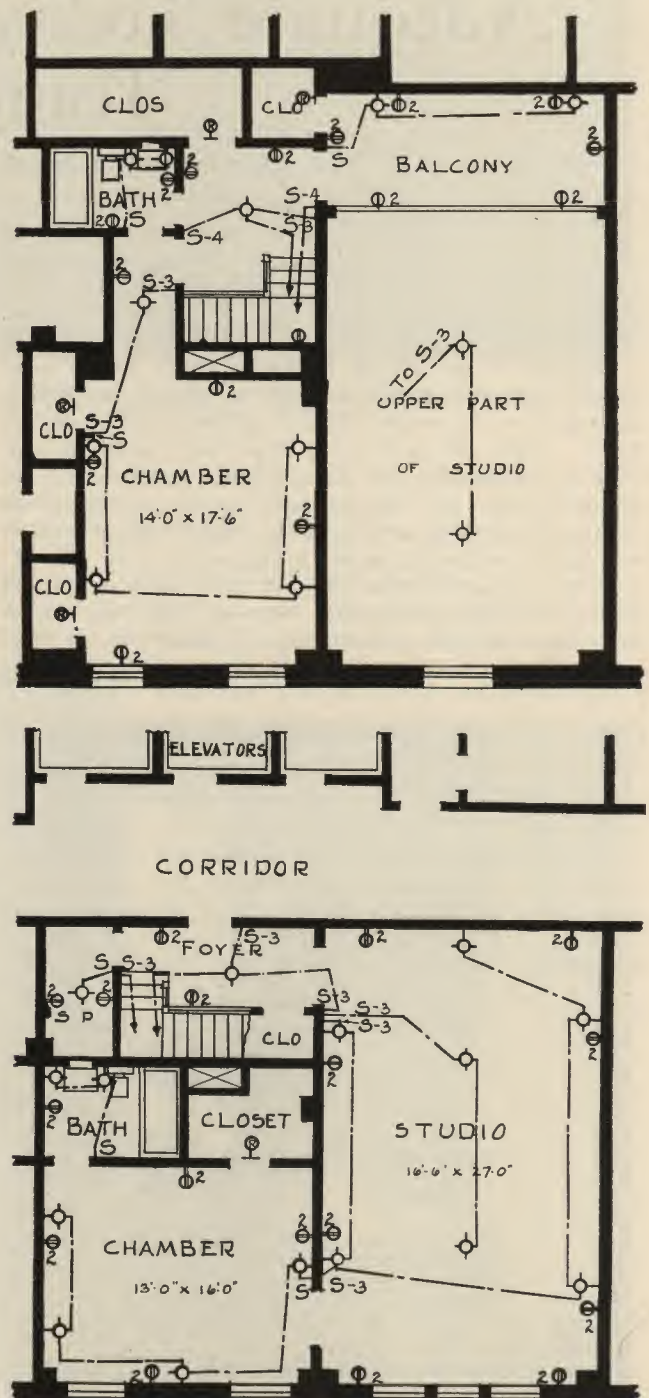
This percentage applies more particularly to multi-family apartment houses or apartment hotels designed to accommodate 50 families or less. In larger and more pretentious buildings 4 per cent should be allowed.

The recommendations for adequate wiring in the living quarters are as follows:

1. Individual panelboards should be provided for each apartment or suite. These should be located at an accessible point in the service quarters. This recommendation is made so that the occupant may promptly and conveniently replace blown fuses.

2. In the panelboard, one spare circuit should be provided for future extensions which cannot be anticipated.

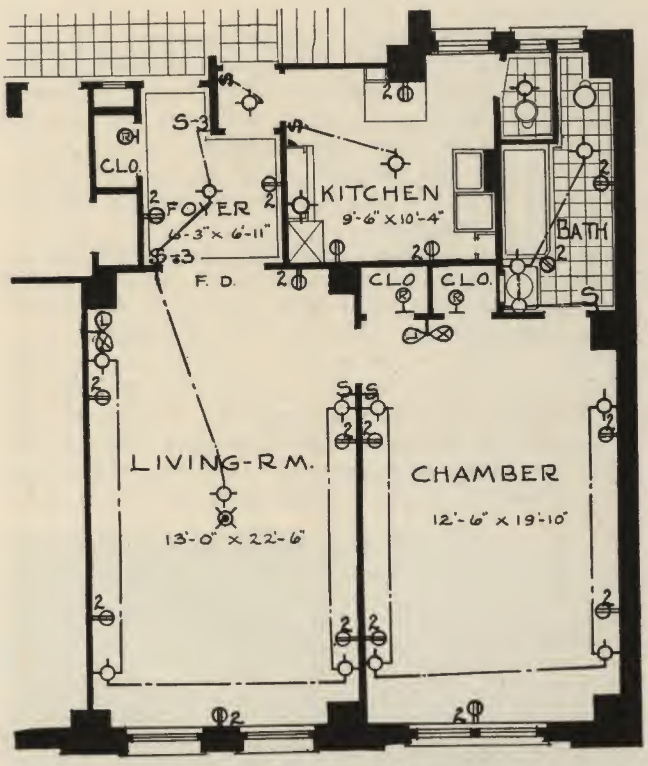
3. A lighting outlet should be provided for each 60 square feet of floor space. These should be divided between ceiling lights and wall lights to provide both general illumina-



Main Floor and Corresponding Upper Floor of a Duplex Studio Apartment, Showing Recommended Wiring. This type of building is in considerable vogue in our larger cities in what is known as apartment hotels.

tion and decorative lighting according to the character of the room. The purpose of this recommendation is to provide for even illumination free from glare. Closets should be included in determining areas and allotting light outlets.

4. A twin convenience outlet should be provided for every 50 square feet of floor space. The purpose of this recommendation is to provide for the convenient use of portable lamps and appliances regardless of the furniture arrangement; and to provide for present and future developments in such devices as electrically operated phonographs, household motion-picture projection machines, radio sets, etc.



Suggested Wiring for a Typical Three-Room Apartment of the Better Sort. In this apartment no separate dining room is used, the living room serving for both.

5. Combination switch, pilot lamp and convenience outlet units should be provided in kitchens, laundries, breakfast nooks and other service rooms for the connection and control of heating appliances. The purpose of this recommendation is to provide for a convenient means of controlling heating devices such as flat irons, ironing machines, toasters, etc., without the necessity for constantly removing and replacing the connecting plug.

6. Switch control should be accessible at every doorway. Passage through any room and any doorway should be as convenient at night as it is during the day time. The inconvenience of groping in the dark for inconveniently located switches is a common experience resulting from the omission of accessible switches at every doorway.

7. Fan outlets should be provided in the principal living rooms. Finding a suitable place for the electric fan is always a seasonal problem in homes and more particularly in apartments. The purpose of this recommendation is to help in the solution of this problem by providing a place for the suspension of the electric fan which is both safe and convenient; and a place which can be located so as to provide the best circulation of air without regard for the location of furniture and furnishings.

In the diagrams presented, practical applications of these recommendations as applied to apartment houses, apartment hotels and hotels are shown.

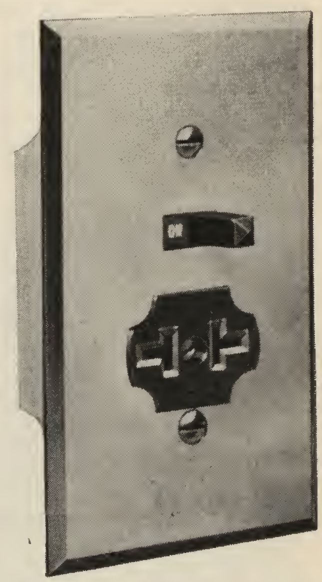
Two New Electric Outlets

KEEPING abreast of the times one manufacturer is supplying a number of new wiring devices that hold particular interest for architect, contractor, and builder because of the economies, and because of the efficiency of these switches, receptacles and other devices for the control of light and power in homes, offices, and other buildings. A combination flush receptacle and double-pole tumbler switch is offered which also fits into a single gang box and takes a single gang plate. This device has the advantage of offering a standard wall receptacle with the added convenience of the switch, again saving in material costs, and in time and labor of installing.

This combination device has the further advantage that it can be used in many installations where single gang flush switches are already installed and where additional convenience outlets are needed. This device can very easily and quickly be substituted in double-pole circuits for flush switches already in use.

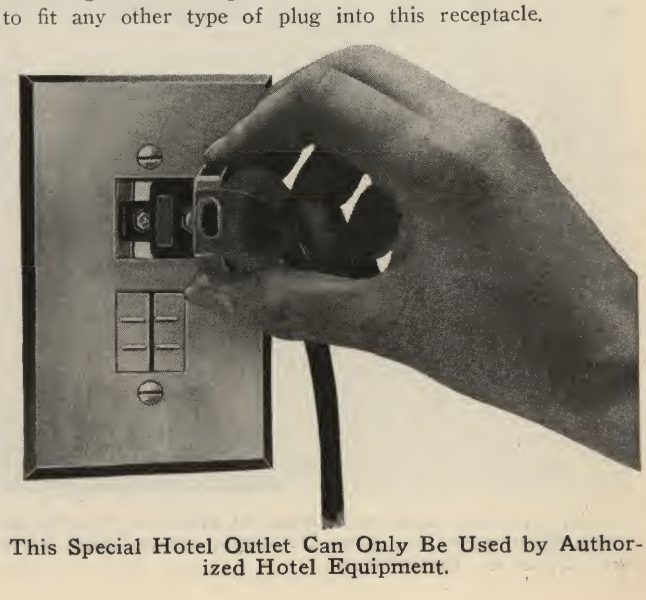
In some installations, particularly medium sized hotels, a high "overhead" expense is often unavoidable because of the unwarranted use by guests, of receptacles in the rooms, for curling irons, heating pads and other devices which they bring with them.

The manufacturer above referred to has a new "Disappearing Door" flush receptacle both single and duplex type that fits into a single gang outlet box and its installation prevents the use of the current except by means of the regular equipment in the hotel, as miscellaneous plugs cannot be used. Both of these devices, the receptacle and the special plug are sturdy in construction, durable, and aid materially in cutting down this serious expense.



Switch and Outlet in the Same Plate.

The "Disappearing Door" feature is another advantage. The accompanying plate is very attractive in any installation and minimizes the chances of short circuiting. It is impossible to fit any other type of plug into this receptacle.



This Special Hotel Outlet Can Only Be Used by Authorized Hotel Equipment.

How Many Bathrooms Should a House Have?

THERE was a time when a bathroom was of very little importance to the builder and for that matter, to the home owner. Builders were concerned with erecting strong, well-built houses. Perhaps a room was designated as a bathroom, but it was the concern of the owner whether or not it was equipped to function as a bathroom. That was in the good old days when bathing was a Saturday night function, before we were taught hygiene and the prophylactic necessities in which every one indulges in these modern times.

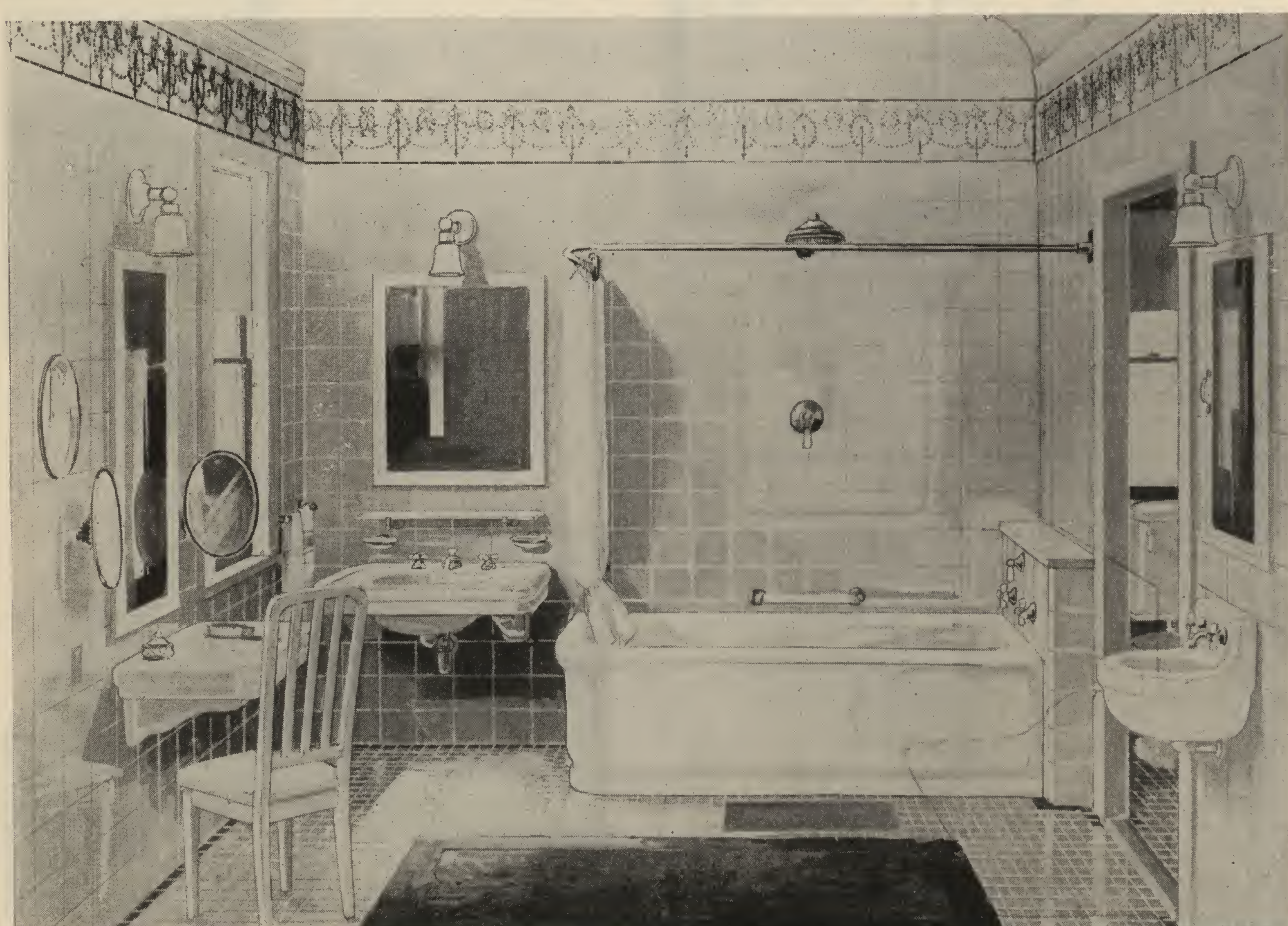
Health authorities, hygienists and physicians began a campaign for cleanliness—the chief item of which was frequent bathing. The idea took hold slowly at first as all innovations do. Suddenly, within the past ten years, it seemed that all at once everyone had the idea that we must all take a daily bath. The result has had a widespread effect on health and efficiency but we are here mainly concerned with its effect on industry, and to be more specific, upon the building industry.

Years ago in a ten-room house one bathroom was plenty—the tub was idle all week, the members of the family had adjusted themselves to a regular bathing time and there was no confusion. In a large family, some of them had to wait over until Sunday morning for their turn. But consider a ten-room house now, with only one bathroom and let us visualize an ordinary family of four people; father, mother and two children. All arise at the same time and consequently the morning ablution period is considerably cramped. Everyone wants to use the bathroom at once. It simply cannot be done.

Therefore we must have more bathrooms to keep peace in the family and to permit each person the necessary time to bathe. There is not any set standard for the number of bathrooms a house or apartment shall have. It is largely in the hands of the builder and the disposition of the owner. But it is safe to say that there should be one bathroom for every three people; or, to put it another way, one bathroom for each two bedrooms.

Sometimes it happens that either the building or the budget will not permit the cost of an extra bathroom. There is a substitute which grows in favor, that already has a widespread use. That is an extra lavatory.

There is always an odd corner or perhaps a space under a stairway in which a lavatory or wash-basin, with hot and cold running water, may be installed. It helps out immensely as first aid to a crowded morning bathroom and it has other uses just as important. In a two or three-story house, a lavatory on the first floor saves many steps and is



The Modern Bathroom May Be Made as Sumptuous and Complete as the Budget Will Allow for Modern Bathroom Equipment Has Been Developed to the Most Elaborate Luxury but Excellent Fixtures Are Obtainable to Fit Any Space or Pocketbook.

a great help to the housewife, as it reserves the kitchen sink for culinary purposes exclusively and permits members of the family who need a wash-up to perform their ablutions without climbing the stairs to the bathroom.

Numerous articles in building magazines have dealt with the equipment and types of general plumbing equipment. And while the subject has been so covered, it is believed that it will be valuable information to discuss here again, some essentials. It may seem expensive or extravagant to add bathrooms in houses that already are loaded up with modern conveniences and therefore it is well to know that additional bathrooms need not cost prohibitive sums.

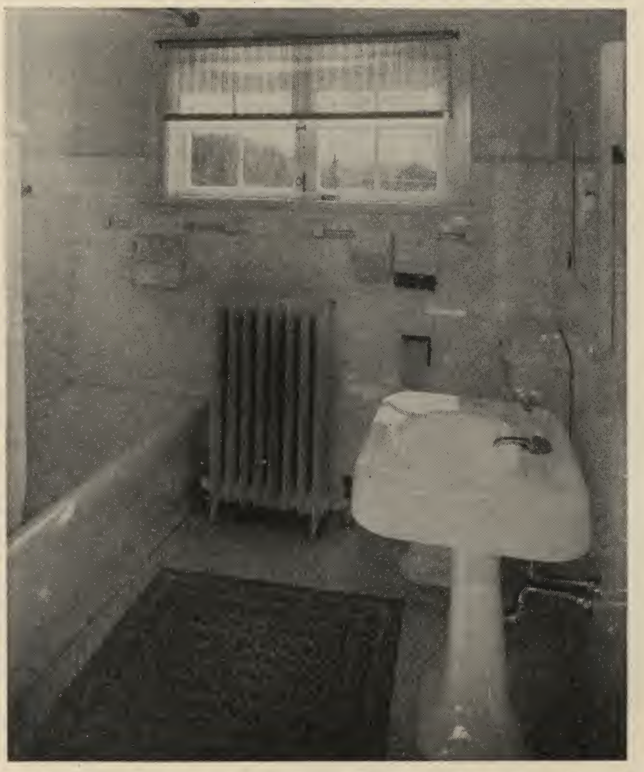
The master bathroom should, of course, be as sumptuous and complete as the budget will allow. It's one of the most important rooms in the house and will stand the best equipment possible. Other bathrooms, however, need not be so elaborate—in fact all the larger manufacturers of plumbing fixtures now feature compact units that fit into extraordinarily small space.

Recently one of the largest manufacturers ran a series of newspaper advertisements showing how a large clothes-closet could easily be converted into a well-equipped bathroom. Tub on one side, closet and lavatory on the other, can be put into compact space and still make a practical and inviting bathroom.

In the larger cities where the old houses are being made over into apartments, contractors have learned how to produce some wonderfully fine bathrooms in unbelievably small areas, and when it is realized that these small bathrooms function quite as well as the larger ones why not take a leaf from the book of their experience?

We will have lots of bathrooms. The more we pay for our house, the more we want. Contractors and builders should carefully study the conditions and like all other business men who are successful, give the public what it wants.

And there is also the basement where the extra lavatory,



Manufacturers of Plumbing Fixtures Are Now Featuring Compact Units That Fit Remarkably Small Spaces and Make Possible More Bathrooms in a Limited Space.

Even the Less Expensive Type of Bathroom Equipment Today Shows a New Degree of Refinement Marking a New Realization of the Importance of the Bathroom.

and a closet, too, will pay for itself many times over. Homes that have a yard or employ servants should invariably have this extra plumbing equipment. And if we can't have bathrooms we must at least have an extra lavatory or two. Recently in a survey of American homes, by the Industrial Survey and Research Service, it was found that in a large percentage of homes (nearly 25 per cent) automobiles and telephones were provided before sufficient running water was used. Thus, it is up to the builder to offer this vital need before the prospect's money goes into other channels.

What about the cost of all this addition to home building? Plumbing equipment can be very expensive and it can be very modest. It is one item upon which careful thought must be expended. Much depends upon the plumbing supply house or the man who designs the plumbing floor plans. It is a good idea to keep in mind that from 50 to 100 per cent of a plumbing installation cost is for labor. When the job is finished it is rather difficult to see where the money went, as much of the work is covered by flooring or plaster. The compact bathrooms, or additional lavatories described, have the advantage of being easily installed, use less supplies than a large room and hence the labor and incidental costs are small.

Plumbing supply houses and branches of plumbing fixture manufacturers all maintain a service that is helpful to builders. These people are interested in selling their materials and fixtures of their own manufacture and can be depended upon to co-operate with you for making suggestive layouts that cut labor costs to a minimum. When you have made a friend of the representative of one of these distributors you will obtain good advice from a practical source.

To conclude, cleanliness is daily growing in demand. The public wants it and must have it. It is a mark of the advance of civilization, and the homes we live in are the monuments to our interpretation of that progress, just as builders are the artists who transfer these interpretations into being.

"THE outstanding characteristic of the modern house is compactness, the elimination of useless rooms. Rooms are fewer in number and the rooms most frequently used are larger. The 'back-parlor,' the small den, the sewing room and intricate hallways are not included in the well planned small house of today."

Insulation Pays for Itself in Both Comfort and Dollars

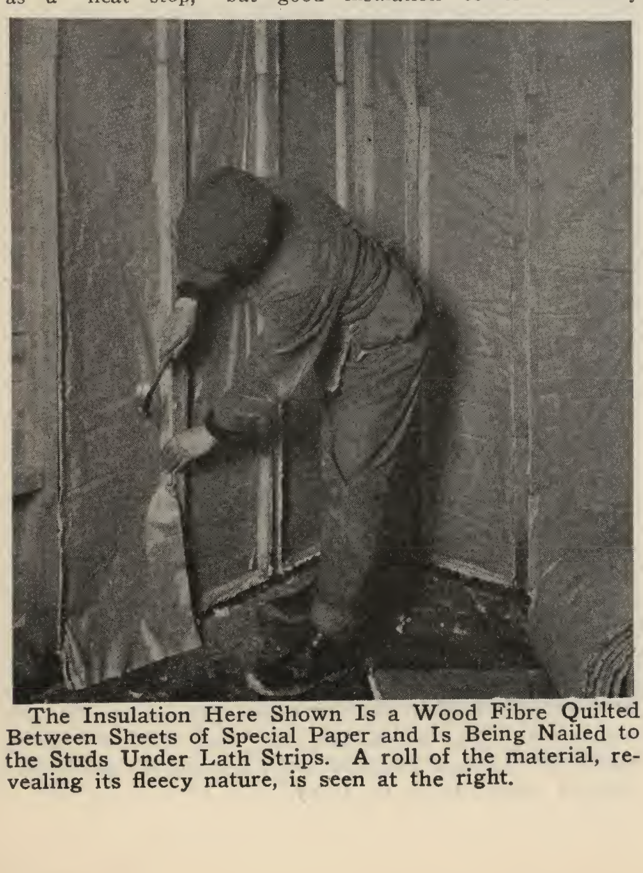
THERE is no doubt about the economy of insulation. It has been demonstrated that it will more than pay for itself if properly selected and applied. From the standpoint of the average home owner, this question is to the point: "Would you rather shovel the money into the furnace or use it to pay off mortgages?" The builder, of course, should consider the best interests of those for whom he builds or to whom he sells and he knows that this policy will pay him in the long run.

A few figures will be given a little farther on showing the actual savings from the use of good insulation, expressed, first in terms of British thermal units and then translated into pounds of coal and cost in dollars. The case is easily proved. But it is equally important to stress, at the outset, the gain in living comfort from the use of good insulation.

A properly insulated house is several degrees cooler during hot weather. The fierce rays of the sun beat upon walls and roof and the amount of heat which gets inside is in direct proportion to the conductivity of the wall and roof construction. Everyone knows how hot it is in the attic of an uninsulated house and heat is conducted through the walls of a house in the same manner but in less degree because the radiation from the sun strikes the wall surfaces at a greater angle.

All materials conduct heat. There is no such thing as a "heat stop," but good insulation comes extremely close to it. Small and numerous dead air spaces are necessary to good insulation and its insulating power is, therefore, in direct relation to its specific gravity. It should have other qualities, of course; particularly in its fire-resistance and non-absorption of moisture.

This Picture Shows a Partially Completed Insulating Job, as Installed by John A. Pugh, Builder, at Schenectady, N. Y. Corkboard one and one-half inches thick is being nailed to the studs and two inches thick to the second floor ceiling joists.



The Insulation Here Shown Is a Wood Fibre Quilted Between Sheets of Special Paper and Is Being Nailed to the Studs Under Lath Strips. A roll of the material, revealing its fleecy nature, is seen at the right.

We are here considering particularly those forms of insulation composed of vegetable fibres or board. Enough of these are pictured to give a good idea of the several types obtainable.

The board type of insulation has the advantage that it can be nailed in place as a sheathing material. It has sufficient stiffness and strength to be used as a sheathing or plaster base and yet it has myriad minute air pockets which make it a poor conductor of heat. Such a material is cork board—the bark of the cork oak—whose dead cells are filled with air spaces and the specific gravity of which is but .24. Cork makes a most efficient plaster base, but has not quite the structural strength of some of the artificial fibre boards and is not used as a sheathing material except over the regular sheathing boards or nailed to the inside of the studding or to the ceiling joists as plaster base. It can be obtained in almost any desired thickness, but is usually 1½ or 2 inches thick. Cork is not inflammable in the ordinary sense and is highly heat resistant.

Another quite effective form of board insulation and one which has considerable structural strength is made from the fibres of sugar cane, felted and pressed together under steam heat. This board is sometimes called artificial lumber, as it has many of the characteristics of good lumber and has sufficient strength and stiffness to be used for sheathing. Asbestos board is also an excellent insulating material and is stiff and fairly strong. It is also said to be an excellent plaster base.

Another type of insulating board is made from wood fibres, felted and pressed into boards. Some of these boards have considerable stiffness and strength, depending upon the degree of compression used in their manufacture.

Their insulating value, however, is in direct relation to their lightness or low specific gravity. They are often used over concrete or metal roof decks, to prevent condensation as well as heat loss. Corkboard is also effectively used for this purpose. When so used, they must be mopped over with hot asphalt for a permanent waterproof roof covering.

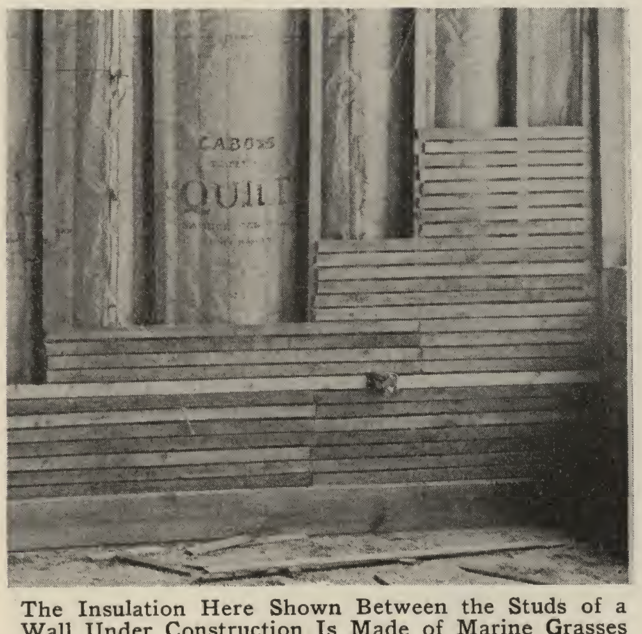
Most of the loose fibre insulations have considerable insulating value, but are usually quilted and have no other function than to impede the passage of heat and the infiltration of cold air. They retain the warmth of a house in winter in much the same fashion as underwear keeps the human body warm and protects it from the chilly blasts of winter.

As shown in the illustrations, most of these quilted insulations are nailed in place between the studs or ceiling joists in such fashion as to create two additional dead air spaces in the wall between the sheathing and the plaster base. The edges are stripped down with lath nailed in place, to make tight edges. Another method is called "threading," the quilt passing first in front and then behind the studs or extra strips between studs.

One of the best loose fibre insulations is made from marine grasses quilted between sheets of waterproof paper. Besides its high insulating value, it is water and moisture-proof, which gives it a long life and adds to its insulating value. This is because wet or moist substances transmit heat readily, even though poor conductors of heat when dry.

Other forms of fibre insulation are made from flax and similar vegetable fibres treated with a fireproofing liquid and stitched between sheets of special paper. Mineral wool is another valuable insulating material and is, of course, absolutely fireproof as it is a by-product of the smelting of iron and steel in blast furnaces.

The invisible loss of heat from a house takes place through both walls and roof. Because of the natural law of gravity which causes heat to rise, the loss through the roof would many times exceed that through the walls were it not for the floors and ceilings below, which have a partial insulating effect. In many houses, however, there is only a lath and plaster ceiling under the roof, and, in such houses, the heat loss through the roof is extremely wasteful. Insulation over such a ceiling should be quite thick—twice as thick as ordinarily used in the walls. This is called "balanced insulation" by some insulation engineers.



The Insulation Here Shown Between the Studs of a Wall Under Construction Is Made of Marine Grasses Quilted Between Sheets of Waterproof Paper. This insulation is impervious to moisture and has excellent insulating qualities.

Here We See the Insulation of a Concrete Roof Deck with Sheets of the Pressed Wood Fibre Type. This insulation is mopped over with hot asphalt as a top finish. It prevents excessive heat loss and condensation or drip underneath.

Of the 22,000,000 homes in the United States, only a small fraction have been protected with heat insulation. The practice is rapidly growing, however, with the prevailing high prices of fuel. If the savings possible by properly insulating the average house are figured on but half the number of homes in the United States, the annual money losses in fuel without this wall and ceiling insulation amounts to $682,000,000—a truly extravagant waste, especially when applied over a term of years. How much better it is to build the new house with good heat insulation in the walls and under the roofs and have the added living comfort, summer and winter, as well as the handsome fuel saving during the life of a building.

After a house is once built, it is impracticable to apply insulation in the walls and full fuel efficiency and economy are impossible in such a house. Therefore, the house with good heat insulation built into it has greater value—is worth more in dollars and cents. Builders should remember this when planning new buildings.

Single dwellings and apartment buildings are by no means the only classes of buildings in which good heat insulation is advisable. From one particularly cold section of the country, a heating problem is referred to the editors of American Builder which showed a shocking heat loss in a community school building. This building had a combined heating and ventilating system by which air was heated over steam coils and rose from the basement through ducts to a hall or auditorium on the second floor which was often used for public meetings in the winter. In spite of burning all the coal they could force into the boilers, it was impossible to keep the temperature of this auditorium above 62 degrees when the thermometer was below zero outside. This was directly due to the tremendous heat losses through the uninsulated ceiling and roof over this auditorium and they were advised to almost double their radiation unless they were willing to install adequate insulation over the ceiling. The people of that community had paid in fuel losses many times the amount which good insulation would have cost in the first place and, probably, the cost of a new boiler as well.

Owners of industrial plants—factories, workshops, foundries and the like—are learning the value of insulating their buildings and many structures of this type are now being

built with heat insulation in the walls and under roofs. Naturally, the dollar argument makes a strong appeal to business men, but there is also the gain in comfort to be considered. During the hot summer weather, employes in the cooler buildings turn out more and better work. Thus there is a double gain.

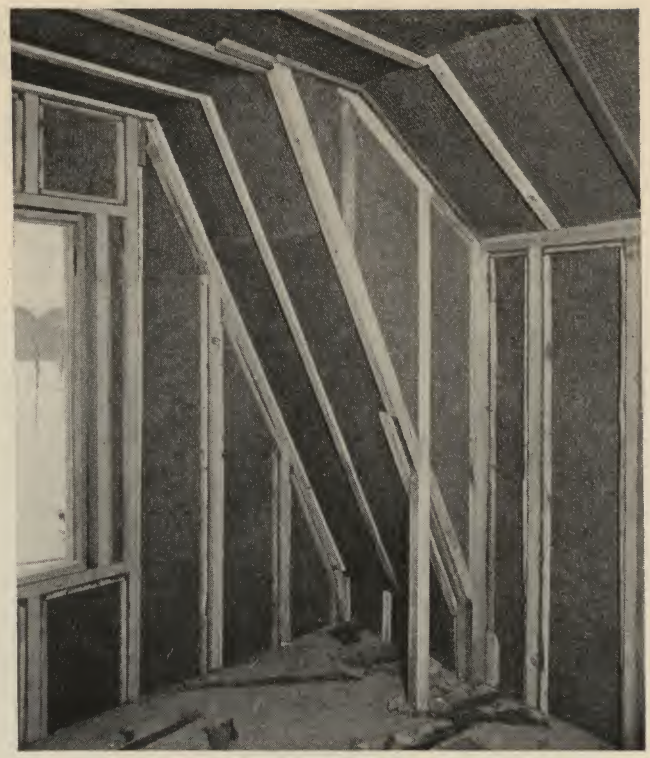
Thermometer tests have been made which reveal exactly the amount of heat lost through walls of various forms of construction and material. Space is lacking to quote all of these results, but only a few such figures are necessary to show the value of good heat insulation. The figures quoted show the heat losses expressed in B.t.u. per hour per square foot per degree F. difference in temperature between the inside temperature and that outdoors.

	Not Insulated	Well Insulated	Extra Thick
Wall Construction No. 1—			
Beveled siding, waterproof paper, sheathing, studding, lath and plaster................	.218	.105	.090
Wall Construction No. 2—			
Stucco on metal lath, furring, waterproof paper, sheathing, studding, lath and plaster..	.236	.109	.092
Wall Construction No. 3—			
Brick veneer, waterproof paper, sheathing,			
Wall Construction No. 4—			
Brick (8-inch), furring, lath and plaster....	.200	.119	.100
Wall Construction No. 5—			
Brick (12-inch), furring, lath and plaster....	.172	.109	.093

If the weather in the city of New York may be taken as fairly representative of average conditions, the number of day-degrees below 70 degrees in one winter totaled 5256, without including September, October, April or May, which have many days with a temperature below 60 degrees in various parts of the country. The degree-days shown are figured on the "mean temperature" reported for New York by the weather bureau during each of these months.

As our heat losses are figured by the hour, it is necessary to translate our day-degrees into hour-degrees. Multiplied by 24, we have 126,144 hour-degrees temperature difference. This gives us a figure which can be multiplied by the heat losses shown in our tabulation, securing, as a result, the losses in B.t.u. per square foot. Figured on this basis and on an external area of 2750 square feet for the average house, the actual money savings of installing good insulation can be shown.

One of the most popular fuels for domestic use costs in the neighborhood of $16.25 per ton in winter. These

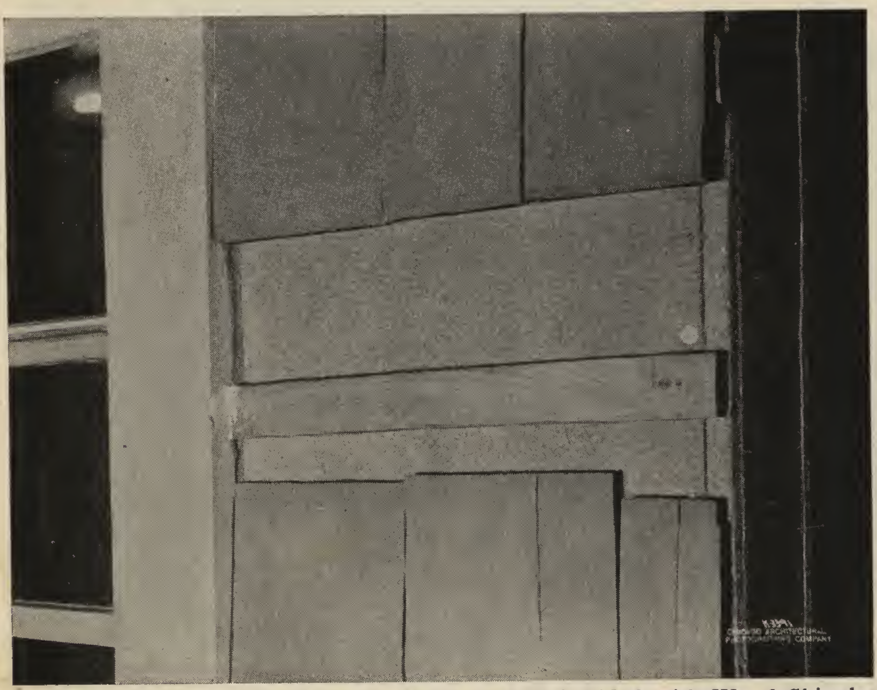


The Insulation Used Between the Studs in This Picture Is Made from Flax Fibres Felted and Pressed Into Semi-Rigid Sheets. It has good heat resisting qualities and is non-inflammable.

are the factors on which the following insulation economies are figured.

SAVINGS BY USING HEAT INSULATION IN THE AVERAGE HOUSE

	Saving in 5 Months with Good Insulation	Saving in 5 Months with Extra Thick Insulation
Wall Construction No. 1..................	$62.08	$70.20
Wall Construction No. 2..................	69.68	79.04
Wall Construction No. 3..................	54.28	62.08
Wall Construction No. 4..................	44.52	54.89
Wall Construction No. 5..................	34.54	43.32



This Close-Up View Shows a Section of Wall Sided with Wood Shingles Under Which Is a Sheathing Board Made of Sugar Cane Fibre Which Is Rigid and Yet Has Good Insulating Qualities. It is sometimes called "artificial lumber."

As about 50 per cent of the coal consumed in a domestic installation is wasted in unavoidable stack losses and faulty combustion, we have doubled the theoretical fuel consumption, to represent the actual saving in dollars, otherwise expended for coal.

As the savings shown would continue throughout the life of the house—say, from 20 to 30 years—it is easy to see that an investment in good insulation returns a handsome profit, besides its great contribution to living comfort.

Wood an Important Fuel

IN connection with the observance of American Forest Week a most surprising fact was brought out. It is that more wood is used every year to heat the houses of the American people than to build them.

Surprising as it is, the fact is borne out by statistics of the United States Department of Agriculture which show that 9,500,000,000 cubic feet of wood is removed from the forests annually for fuel and 8,256,000,000 for lumber.

Skintled Brickwork

THERE have been noteworthy developments in the effects obtainable in brickwork during the past twenty-five or thirty years. Even the casual observer knows that there has been a great advance, that the effects obtained today represent great strides over the practice which prevailed in his boyhood days. Yet the great multiplicity of effects now produced, if analyzed, reveal the fact that they are all due to not over two or three fundamental changes or variations of the practices of half a century ago.

Skintled brickwork is the most recent of these fundamental steps in the logical development of brick effects. It has awakened a large response from prominent designers throughout the land who are alive to the new opportunities that skintled brickwork affords as a vehicle for expressing their conceptions, especially in the residential field.

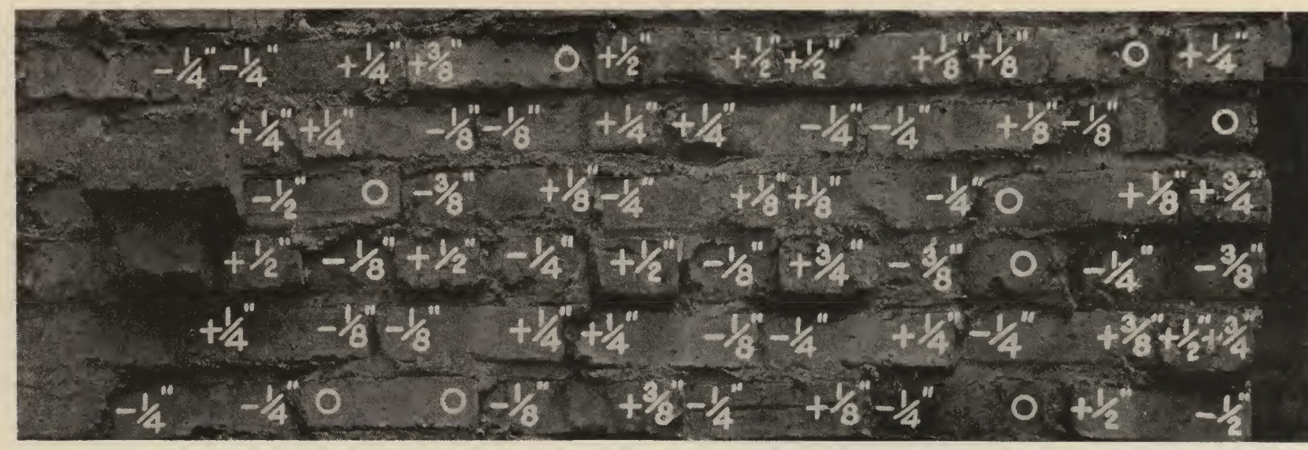
In the early days of this republic there was a greater appreciation of the nature and of the proper use of brickwork than prevailed at some of the later periods, now happily passed. Such outstanding examples as Independence Hall, the old State House in Boston, and many other buildings which are now national monuments, were constructed of brickwork—which displayed the natural slight irregularities in the brick units, both as to form and color, which form one of the chief reasons for its charm. A brick is a clinker of Mother Earth. By nature it is rough and rugged. Brick clay has successfully withstood great convulsions of nature, terrific heat and glacial action, and brick is among the most nearly permanent of all the materials on this globe. Brickwork is never so charming as when these characteristics are clearly expressed, and as might be expected, the historic buildings mentioned, which well typify the brickwork of that time are laid of brick of which the face is not too smooth, and with corners that are not always too mechanically sharp and square, and exhibiting those slight differences in shade which result from the irregular action of the fires in the kiln.

Such brickwork always satisfies the eye and may be properly regarded as standard brickwork.

But with the Victorian era there came a decline in architecture and the crafts. Strained and false effects became all the rage. Everybody remembers the time when a sort of observatory or cupola on the roof was the hall mark of distinction in house design, and bargeboards and wood porches were marvels of jig saw patterns, and mansard roofs and cast iron dogs dominated the scheme of things. The debasement of taste was equally expressed in interior architecture. High and narrow rooms and porches, marble fireplaces of weird design and mantelpieces with many shelves on slight spindles were the pride of their owners.

And brickwork suffered too. Monotony of effect was the cherished goal. Every brick had to be absolutely perfect, with sharp corners, face in a perfectly even plane, and in color and shading each brick had to be as alike as two peas. And the mortar joint was a thin hair line. The effect was a forced and unnatural appearance entirely unfair to the material, but in entire harmony with the ideals of the mid-

A Close-Up View of Skintled Brickwork as Used for a Home in One of the Fine Residential Suburbs Near Chicago, Showing the Beautiful Soft Texture of the Wall. James Roy Allen, architect.



Detail of the Type of Skintled Brickwork Used in the Home Shown Below. This is known as skintled brickwork, C. B. M. A. effect number three. The numbered notations show amount of variation of each brick end in or out from the normal vertical surface designated "O."

Victorian era. And it was not only new brickwork that was thus affected, but many of the finest examples of brickwork on the continent were painted over to make them look slick and smooth, and in some cases artificial points were painted with white paint over the red painted background. The old State House in Boston recently had its coating of paint sand-blasted off and the brickwork restored to its former beauty. The device known as "tuck pointing" was in its glory in those days. This mistreatment of old brickwork consisted in first filling the joints with cement flush with the brick and then coloring the entire face of the wall by rubbing it with pieces of soft brick or with a mixture of copperas and pigment, afterwards putting on thin white artificial joints with lime putty. Sometimes these "joints" were raised, and ran impartially over brick and real joint alike.

This period of strained effects, both in brickwork and in architecture generally obviously could not last. In the 80's came the Romanesque revival, and then followed the restoration of good taste and development of good architecture, which has proceeded steadily to the present day. And this period has witnessed the remarkable development in brickwork effects before referred to. Brickmakers, always striving to please their patrons, could not at first quite realize that the day had passed when a keen-eyed sleuth of an inspector would condemn every brick that departed but slightly from the color of the sample. The classic example, of course, is that of Stanford White, who found on a brickmaker's cull pile the beautiful brick he selected for the gates of Harvard University (this brick being afterward named Harvard brick).

The appreciation of the real nature of brick returned, and architects again began to create masterpieces in which the harmonious blending of the slightly varying shades of the individual bricks, and the slight roughness of their surfaces, together with the proper value given to the mortar joint, all played an important part. Then followed the period in which brick, with a deliberately roughened face, creating most interesting textures, was popular. These rough texture effects still have a wide vogue and probably will continue as permanent and deserved favorites of a large number of architects and of a considerable proportion of the public.

Skintled Brickwork, the Most Recent Step in the Development of New and Attractive Brick Walls, Originated Among Chicago Architects About Four Years Ago. This house is an example of the work of S. S. Bemen, architect.

And as a logical and inevitable step in the development of these artistic effects, skintled brickwork was fully developed by prominent Chicago architects about four years ago.

Briefly stated, the underlying principle of skintled brickwork is to produce strong light and shade effects by the projection and recession of the bricks themselves with respect to the normal wall line, assisted by the irregular finish of the mortar joint. The illustrations which accompany this article tell the story much more completely than a written description could do, but even so the finest illustration cannot do full justice to the rich and harmonious effects which this type of bricklaying produces, because the lights and shadows only are emphasized, while in reality the color of the brick and of the contrasting mortar joints also play an important part and add to the striking beauty of the wall surface.

In the fashionable suburbs which skirt Chicago it has been conservatively estimated that between four and five hundred skintled brick houses have been built, all of them by the city's best architects. And the low cost of skintled brickwork (almost always skintled brickwork is constructed with common brick) is emphatically not the reason for its wide and spreading popularity, for almost without exception these houses cost between $15,000 and $75,000 each. This achievement of beauty with economy has a significant appeal to the builder, however, who is constantly seeking to reduce his costs legitimately and still deliver full value to his clients.

Not only is the wall material itself low in cost, but the bricklayer can lay more skintled brickwork per day than the older types of traditional brickwork. There is nothing difficult or complicated about it. Any good mechanic worthy of the name can lay it without previous experience, if he uses a little care in placing the first few courses. The bricklayers who have had experience with skintled brickwork are justly proud of these beautiful effects.

A contractor who has had much experience with skintled brickwork states that he can conservatively and safely estimate that a bricklayer will lay 1,000 brick per day in an 8-inch wall, and 1,500 brick per day in a 12-inch wall.

The line is generally placed at the back of the wall.

Skintled brickwork has already spread far and wide the country over. It is destined to make a deep impression upon architecture. It will be used more and more because it is beautiful and yet is economical.

Treated Lumber for Houses

THE careful builder of the future will use chemically treated lumber wherever decay favoring conditions exist about the house, according to predictions made by M. E. Dunlap, of the U. S. Forest Products Laboratory.

"The use of treated wood, and particularly 1-inch and 2-inch boards impregnated through and through, will offer a solution to the decay problem of the home owner just as the use of treated ties has enabled the railroads to reduce their tie renewals by 60 per cent or more.

"At present retail lumber dealers do not carry stocks of treated boards or timbers nor do treating plants exist which specialize in treating ordinary lumber. Treated boards for ordinary construction work, to be really resistant to decay, must be impregnated through and through, a result difficult to obtain except in efficient, large scale, pressure impregnation plants.

"With the use of thorough treated boards the builder will be free to cut boards to length at will without the necessity of resorting to the not always dependable brush treating method used to cover untreated wood exposed on cut ends.

"For many purposes treated boards to be really marketable will have to be painted although this will not be true for all uses. In many places it should prove practicable to use creosote, a preservative which has so far proved difficult to paint."

Anticipating the demand for thorough-treated lumber the U. S. Forest Products Laboratory has started studies both of methods of getting complete penetration of building lumber and of painting over woods impregnated with zinc chloride, sodium fluoride, creosote and other preservatives. Results of these studies, according to Mr. Dunlap, will probably not be available for some time but it is expected that the study will be well abreast of economic developments leading to the general use of treated lumber.

On July 4, 1926, the Formal Opening of the Largest Suspension Bridge in the World Was Held. This bridge, spanning the Delaware River, at Philadelphia, and connecting that city with Camden on the opposite shore forms a new link between the states of Pennsylvania and New Jersey.

Rejuvenating Masonry Buildings

An Expert in Cleaning, Pointing and Renovating Brick, Terra Cotta and Stone Explains the Methods Based on Many Years' Successful Experience

MANY a building of brick, terra cotta or stone becomes, in the course of a few years, so weatherbeaten and soiled that it appears to have passed its days of usefulness although, in fact, it is still a fine piece of architecture and structurally as sound as ever. Especially is this true in industrial centers where the acid of coal smoke attacks and discolors the masonry walls. With the walls dirty and discolored and the mortar joints partially washed out, the effect is discouraging but all that is needed to rejuvenate the building is a thorough cleaning and pointing.

When properly renovated the old building will be as good as new and an attractive part of the scene instead of the eyesore it has become. All too frequently, however, such a renovation is never made, because there is no one with the expert knowledge to handle the job, and the building rapidly deteriorates in value and structurally as well.

The Deaconess Home, at the Philadelphia Entrance to Delaware Bridge, Restored, Is a Handsome and Substantial Building of Brown Stone and Brick.

The correct methods of renovating the different types of masonry and removing the various kinds of dirt and discolorations are not generally understood. They may be learned, however, from those who have had experience in this special work and this chapter has been prepared to share with other builders the experience of many years of successful renovating of buildings. The E. C. Crean Company, of Philadelphia, has tested its methods on every type of masonry, and has a long record of satisfactory work. Mr. Crean's instructions follow.

Pointing and Cleaning Brick

When red brick walls have become weatherbeaten, dirty and discolored, mortar has been washed out by the elements and the bricks have begun to decay, the following is the best looking, most durable, practical and economical treatment the writer has been able to learn. This method has been used for 20 years and more on hundreds of brick buildings in Philadelphia and nearby cities. Front walls being most generally treated in this manner.

Before It Was Renovated, the Deaconess Home, Shown Above, Made a Poor Appearance with Stained Brick and Stone and Washed Out Mortar Joints.

First all joints, cracks and broken or decayed bricks are pointed smoothly with a mixture of portland cement and bar-sand, mixed half and half and colored with dry, metallic brown.

The bricks are then painted with a weak solution of hydrofluoric acid, mixed with water. A wood bucket must be used to hold the acid solution and a leather bound manilla brush for painting it on the bricks. This is then washed off with a sponge and clear water. A few square feet are done at a time. This removes all carbon, dirt and discolorations leaving the bricks perfectly clean.

Care must be taken that acid does not splash on any glass as it removes the polish and streaks glass. Acid streaks on glass can only be removed after much patient rubbing with a damp cloth and powdered pumice stone. This acid will also burn the skin and unless skilled in applying same, it is best to wear rubber gloves. White marble is also discolored with hydrofluoric acid.

After bricks are clean and dry, coat with one coat of pure linseed oil to which has been added some dry metallic brown. About five pounds of metallic brown to one gallon of oil is a good mix. This mixture must be stirred thoroughly before applying it on the bricks.

This stain dries in flat and restores the bricks to a natural dark red pressed brick color. The linseed oil, incidentally, waterproofs the wall and since it penetrates into the pores of the brick it cannot crack, peel or blister and will not wash off.

After the oil-stain has been allowed to dry, about 24 hours being necessary, even, uniform lines are then striped over the joints with white lead mixed in oil. A straight edge and small lining brush being used for this operation.

Here Is a "Before and After" View of The Lawrence-McFadden Co. Building in Philadelphia. A striking change was accomplished by merely cleaning the walls and pointing up the brick.

This gives the brick wall a very beautiful finish and one that will last for years.

A painters' swinging scaffold is best for this kind of work, being easy to put up and take down and it can be raised, lowered and moved quickly along the wall.

On rear walls where appearance doesn't count so much the cleaning, staining and striping can be eliminated, pointing alone is sufficient. The best mixture being portland cement and bar-sand mixed half and half. Cracked and sagging walls are strengthened considerably when pointed with cement and leaky and damp walls are made watertight. It is always advisable to point a wall before these defects occur.

There are a number of pleasing effects that can be accomplished to suit individual tastes. After the bricks have been pointed, cleaned and oil-stained black lines can be striped along the joints using drop black or lampblack mixed with oil. The bricks can be cleaned and oil-stained and then pointed with a mixture of white cement and marble dust mixed half and half. Black mortar can also be used for the pointing. The best mixture being portland cement and bar-sand mixed half and half with dry lampblack and a little metallic brown added.

Cleaning and Pointing Granite

A granite building, with terra cotta dome, had been accumulating dirt and soot for about 30 years before it was cleaned by the following method: Two swinging scaffolds were hung on the building. Two mechanics worked on each swing and one helper on the ground to keep them supplied with necessary tools to carry on the work and to keep the ropes out of the acid water and clear of passing pedestrians.

A weak solution of hydrofluoric acid mixed with water was painted on the wall, a few square feet being done at a time and then washed off with clear water. This brought the granite and terra cotta up clean and new in appearance removing all dirt, soot, stains and discolorations.

A small pump was used to force the water through a hose up to the scaffold and the pressure was strong enough to wash off the acid solution and dirt from the walls. The pump eliminated about four water-boys on this job although on small jobs it would be more economical to have a boy carry water in buckets. The mechanic in the latter case would use a sponge and wash off the dirt. Sometimes a scrubbing brush is also necessary.

The windows near where the men were working were covered with canvas to protect the glass. A 20-foot swinging stage was rigged on the dome also. When a stretch of wall was washed down the scaffold was hoisted and the mechanics pointed the joints which had been washed out by the elements.

It was figured that with every man working hard for eight hours daily the job could be complete in 30 days. The man that will push continuously to accomplish more than an average day's work on any job is the exception and not the rule, unless some incentive is offered over and above the usual compensation.

Each mechanic was offered a bonus of $50 to complete the job in 30 days. The boys were out to get the $50 and the work was completed four hours less than the time limit set upon. This cut the working time down 10 to 15 days, saving considerable additional expense.

Great care must be taken that the acid is not too strong or it will turn the granite a rust color. The acid should be weakened with water, so that it is sufficiently strong to loosen dirt only, and it must be promptly sponged or scrubbed off using plenty of clear water.

Terra cotta and brownstone are cleaned the same as granite. Brownstone must be

A Partly Finished Job of White Ribbon Pointing on an Old Stone Barn Built in 1775. It is still perfectly sound and since being renovated and remodeled has become one of the most attractive residences in Upper Darby, Pa.

scrubbed well with a brush and the acid mixed properly with sufficient water. It is easily turned to a rust color if not properly done.

Washing Paint Off Bricks

For many years the brick walls in this part of the country have been puttied and painted. All joints were filled with putty, a thick coat of red lead was applied and then a coat of flat red consisting of brick red ground in oil mixed with turpentine, after which the bricks were lined with white lead. This made a very good looking job for a few years, but the heavy paint cracked and peeled off, the putty fell out and the wall looked far worse than before it was done.

When a wall is covered with scaling paint the only thing to do is wash it off. Lye dissolved in water is painted on the wall with a manilla brush, then the wall is scrubbed with a sharp bristle brush and sponged off with clean water. Several applications of lye are sometimes necessary when the paint is very thick. Rubber gloves must be worn to protect the hands as the lye is bad stuff to handle and it is advisable to nail a stick on the scrub brush and grasp the stick when scrubbing paint.

Plenty of water must be used and the scrubbing with lye continued until the brick show up clean. The putty is then raked out with a sharp tool, or if hard cut out with a hammer and chisel. The wall is then renovated by pointing, cleaning, staining and striping as previously described.

Sometimes the lye remains in the bricks after washing off paint and it may spot up the oil-stain. To avoid this let the job stand for some time (four to eight weeks) before staining.

If marble or stone has been used with a painted wall that is to be washed off, it must be painted with a thick mixture of hydrated lime with a little portland cement added. This prevents the dissolved paint from soaking into the stone and discoloring it. After the paint has been washed off the lime is scraped off the stone.

Cleaning Marble

Marble that has become black and dirty can be quickly cleaned as follows: Get some old and worn out files or defective files from a file maker. Break the end of the file off with a hammer. This will leave a sharp edge. On the pointed end of file attach an old trowel handle. With the sharp end of the file cut the dirt off the marble until it shows up clean.

Wet the marble with water while cutting off the dirt. When the sharp edge on the end of file gets dull break another small piece off the end. After cutting off the dirt with the sharp file, take a small piece of an old grindstone or emery wheel and rub over the marble making it smooth and white. The marble can be easily kept clean, thereafter by rubbing occasionally with pumice stone.

Cleaning Limestone

Dirty limestone is cleaned by brushing with a coarse wire brush and then rubbing with a piece of stone and water as described in cleaning marble. Where black weather grease in encountered cut with a sharp file first.

Pointing Stone Walls

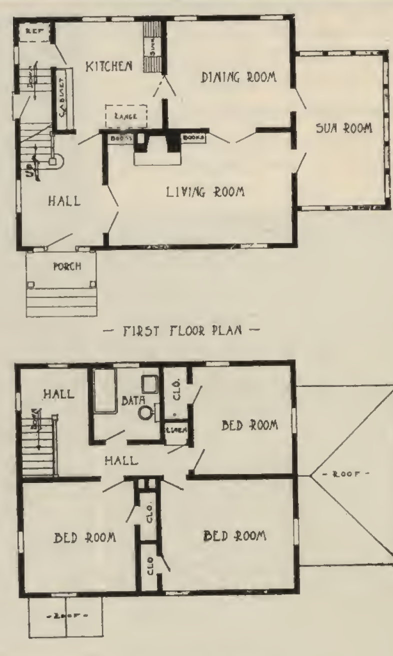
The old stone barn in the picture, built in 1775, was being remodeled into a modern suburban dwelling. First the joints were pointed with portland cement and bar-sand with a joint about 2 inches wide. A few yards were pointed at a time and while the mortar was soft a thin coat of white cement mixed with marble dust was troweled over the portland cement mortar.

A small cutter made out of two pieces of pointed tin tied to the end of a 1-inch stick was used to cut two fine parallel lines in the wet mortar. With a small trowel the cement mortar on the outside of the parallel lines was neatly trimmed off leaving a 1-inch white ribbon joint around each stone. Part of the work can be seen completed in the picture. If the white finish is not wanted a cement color finish can be obtained omitting the white cement and marble dust. Where the stones in a wall are more or less square a straight edge can be used to guide the cutter, making the joints uniform and square.

Here is an example of the home which, because of being kept well painted is always salable, does not require expensive repairs and is preserved through many years of useful life.

New Homes From Old Houses

A Transformation Effected by the Application of Stained Shingles Over Old Siding Is Shown in These "Before and After" Views of an Old House.



The Floor Plan Was Good and with the Addition of the Sun Room Became Modern.

ANYONE can recall seeing old houses, perhaps of the box-like square type pictured on this page, which appeared wholly out of place among their newer and more attractive neighbors. There are many such houses throughout the country and often the owner dislikes to part with the old home even to obtain a more attractive and more comfortable modern one. This feeling may be in a large measure justified because these old houses are frequently of good sound construction and it is only in finish and minor details they fall below the present-day standard.

Remarkable transformations are being wrought in many of these houses simply by the application of stained shingles, the possible addition of a room or two, the modification of a roof line or the remodeling of an entrance, together with interior work incorporating the modern improvements.

A striking contrast in appearance is seen in the "before and after" views presented here. A cozy sun parlor added, the entrance moved to the left, making possible a large, well lighted living room, and a new all-over coat of shingles, including the roof has done the work. In this case the shingles were laid in wide courses alternating with ribbon courses. For the ribbon courses, the use of 12-inch shingles effected a substantial saving in the cost of material with as tight a job as would have been possible had the longer shingles of the wide course been used in the ribbon course also. Reroofing was done with 16-inch shingles stained an attractive moss green, which, with the gray of the side walls and white trim, carried out a charming color scheme.

The cost of this sort of remodeling need not be great; in fact, there is no more economical way of overcoming the forlorn appearance of an old house. It is not necessary to remove the paint from the old siding, the shingles are

applied direct to the weatherboards and this eliminates patching while, at the same time, increasing the weather-proof qualities of the walls and providing greater insulation against cold in winter and heat in summer. The decreased cost of heating the house will go far toward paying the cost of remodeling. And the original cost is little more than painting would cost if the old paint had first to be removed.

After being applied, creosote stained shingles require nothing more than a brush coat of stain every five or six years, at a small cost, to renew their beauty and preserve them almost indefinitely. If properly applied with zinc coated nails and stained at the periods mentioned, the shingled wall will last almost indefinitely.

Long, heavy butt, 24-inch shingles have proved the most popular for recovering old siding, as this size allows of exposures up to 11½ inches, giving the wide course lines so much desired in present-day design. However, the 12, 16 and 18-inch sizes are also used extensively, as stained shingles in these sizes, when 100 per cent edge grain, may be laid to 5½, 7½ and 8½-inch exposures, respectively.

Stained shingles may be obtained in many different colors, giving a wide choice in the selection of color schemes, but the several shades of gray seem to be most popular for remodeling work, as this color harmonizes most often with the surroundings.

A Very Popular and Economical Sidewall Design of 12-Inch Shingles, Sometimes Called the "Ribbon Course." It is laid with 6-inch exposure for the wide course and 2-inch exposure for the narrow course.

There is a wide variety of laying available to give distinction to the house and some of these are illustrated here. The wide exposure is at the height of its popularity today and the wide course and ribbon course, with numerous variations, is frequently seen. Departure from straight lines is also favored and this is possible without extra labor cost by the use of shingles with butts shaped at the factory, as shown in one of the accompanying illustrations.

Recovering old siding with stained shingles is an economical and practical method of beautifying old buildings. It is economical because the cost, in many localities, is little more, and in some cases actually less than the expense of taking off the old paint, patching and repainting the old weatherboards.

While it is impractical to give hard and fast cost figures, due to the wide differences that exist throughout the country in the cost of materials and labor, the following figures, based on averages from various sections of the country, will serve to give an idea of the low cost of shingle-covered walls.

Twenty-four-Inch Shingles with ½-Inch Butts Give Deep Shadow Lines to the Side Walls and Allow Wide Exposures up to 11½ Inches. This size is widely used both for recovering and for new work.

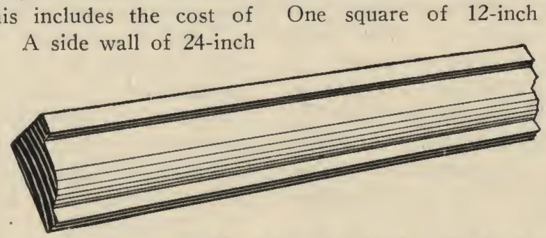
A Section of Wall Recovered with 24-Inch Angle Butt Shingles. Departure from straight lines is made with pleasing results. No extra labor is necessary to lay these shingles as the butts are shaped at the factory.

This Triple Course Design Is Laid in Alternate Courses of 9, 4 and 2-Inch Exposure. The 16-inch shingles may be used throughout or the 12-inch size substituted for the 4 and 2-inch courses at a substantial saving.

A Recovering Job Partially Complete. Note that the shingles are placed over the corner boards as well as the siding. A moulding is nailed on sides of window casings to receive the added thickness of the walls. On casings which do not have an extended drip cap the moulding should also be placed across the top of casing.

To rejuvenate an old weatherboard side wall, repairs amounting to $1.00 or $2.00 per square (100 square feet) are usually necessary. Many painters charge $4.00 to $5.00 per square for burning and scraping off the old paint preparatory to applying the new. Two coats of paint will, in most sections, cost at least $5.00 per square. This makes a total of $10.00 to $12.00 per 100 square feet for a good job of repairing and repainting.

Recovering old weatherboards with 16-inch gray, stained shingles, laying them 7½ inches to the weather, which allows for two full laps, will, in the average market, cost $10.00 to $12.00 per 100 square feet. This includes the cost of shingles, zinc-coated nails and labor. A side wall of 24-inch stained shingles will average about $13.00 per 100 square feet while slightly higher in cost the 24-inch size is preferred by many because of the artistic wide course and heavy butt effects which are possible.



This Type of Moulding of ¾ by 1½-Inch Size Will Serve for Any Size of Shingle from 12 to 24-inch.

These cost figures readily show that stained shingle side walls cost only a very little, if any, more than re-painting. In some localities prices of material and labor will lower the figures given while in others the cost may be higher.

In considering these comparisons one must not lose sight of the additional ability given the house recovered with shingles to ward off cold in winter and heat in summer, as red cedar shingles are one of the best known insulators. Another very important factor is that of upkeep. Here, too, the stained shingle side walls show a nice saving. In place of re-painting every two or three years only a brush coat of stain every five or six years, at about one-half the cost of a two-coat paint job, is necessary to renew their original beauty, and preserve them against the weather. Such a side wall will give practically life-long service and freedom from practically all repairs.

In applying shingles over old siding, a moulding is nailed on the sides of window casings to receive the added thickness of the walls. On window casings which do not have an extended drip cap, moulding should also be placed across the top of the casing. Three-quarters by 1½-inch moulding of the pattern shown in the illustration will serve for either the 12, 16, 18 or 24-inch shingles.

Four-penny, zinc-coated nails should be used for applying stained shingles over old siding. The 1½-inch length of these nails allows them to secure a firm grip, even when so placed that it is necessary to reach through the space left directly below the butt of the clapboards. It is advisable to renail all loose clapboards before applying the shingles. It is folly to apply a fifty-year wall or roof material with wire or galvanized shingle nails. Zinc-coated nails should be used to insure a life-long service from the shingles.

Following is the amount of four-penny nails required for the different sizes of stained shingles:

	Pounds
One square of 12-inch or 16-inch shingles	6¼
One thousand 16-inch shingles	8¼
One square 18-inch shingles	5¾
One thousand 18-inch shingles	8¼
One square 24-inch shingles	2¾
One thousand 24-inch shingles	8¼

There is considerable difference between good and poor cedar shingles. With flat or "slash" grain shingles it is practically impossible to make the smooth, glassy surfaces of the flat grain hold the colors. Even the small amount of color pigment which does adhere is quickly washed off by the first few rains.

In contrast edge grain shingles give a straight grain free from such surfaces and defects. They readily absorb the stain and retain a maximum amount of the color pigment. The result is uniform, durable colors. The cost figures which have been given here are based on the cost of the best edge grain shingles.

Waterproofing Rocks

It sounds paradoxical to think of attempting to keep water out of rocks and stones, but the new process is being widely adopted by builders and architects for preserving masonry and adding to its life. The process is simple and founded on scientific principles. First the stone is heated by the flame of a blow torch, so that the structure of the surface is expanded. Then into the opened pores paraffine is plugged with a brush, thus effectively closing the surface to the action of rain, frost and gas fumes in the air. This method was used for waterproofing the stone work in the $650,000 Buckingham Memorial Fountain, in Grant Park, Chicago.

Mortar for Cold Weather Work

WITH the approach of winter, engineers, architects, contractors and builders again take up the study of how to handle their materials so as to avoid the delays and dangers of frozen mortar, plaster and concrete. Every year sees a greater volume of winter work, with profit to the contractor, convenience to the owner and an extended season of employment for the workman. All organizations interested in construction are urging a twelve-month building year, and are studying materials and methods in an effort to determine how this may best be secured. An accurate knowledge of the properties of the materials used is essential, and one of the basic materials is mortar.

The Engineering Society of Wisconsin has been interested in this subject for several years and conducted an extended series of tests on various mortars at the University of Wisconsin. Their report has just been published by the university under the title "Results of Strength Tests on Mortars for Masonry Construction Cured in Warm and Cold Temperatures."

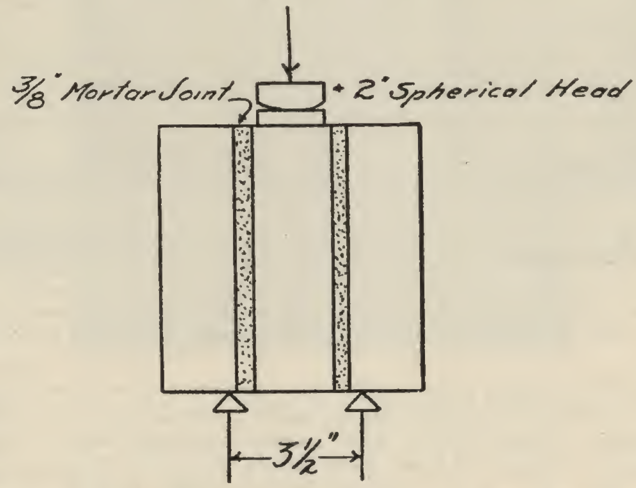


Fig. 1. Method of Making the Shear Test. At the bottom knife edges on spherical seats are used.

Eight lime and portland cement mortars and four proprietary bricklayers' cements were tested for shear tensile and compressive strength after curing in warm and cold air storage. The warm storage specimens were cured at an average temperature of 70 degrees F., while during 1923 the cold storage temperature averaged 47 degrees F. the lowest being 31 degrees F. In 1924 the average temperature for the first week was 15 degrees F., and for the first month 45 degrees F. In 1923 the cold air curing was done in a compartment below the mixer house, but in 1924 it was done in a refrigerator. Air was circulated in the freezer by means of an electric fan which was kept running throughout the test.

Figures 1 and 2 show how the shear and compressive strength tests were made. Standard briquettes were used for determining the tensile strength. The shear test was made on the three brick specimens and the two bricks which remained bonded together after this test were then cleaned and crushed to determine the compressive strength.

The accompanying charts summarize the results of these tests. Warm storage results are shown on the left of each chart, and may be compared with cold storage results which are shown on the right. These charts make an interesting study for those who are interested in getting the maximum results for their money. Economy is always desirable and, of course, safety is essential. A study of the figures will show how both safety and economy in mortar may be secured. Mortar E, composed of one part of portland cement, two parts of lime and nine parts of sand by volume, gave consistently satisfactory results under all storage conditions.

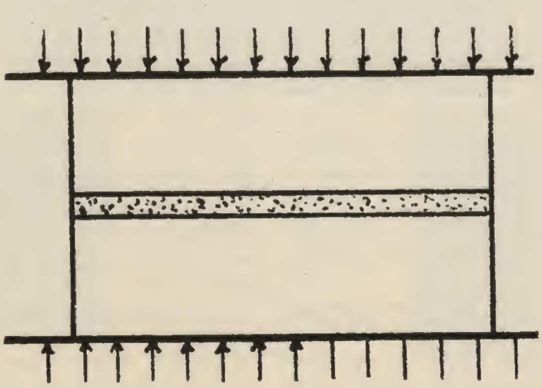


Fig. 2. Method of Making the Compression Test. Above is the spherical head, below the platform of the machine.

Shear Tests

Shear comes into play in the bond between bricks. This bond must be sufficient to resist side pressure against the wall, displacement of the building units, and bulging. In winter work it is usually bulging that gives the most trouble, and this must be avoided by using a mortar reasonably high in shear strength.

As will be seen from the chart, the lime-cement specimens ran high in warm storage, and when tested after being cured in cold storage the results were likewise excellent. Mortar E, which contained twice as much lime as cement, was almost as strong as straight portland cement in warm storage, and held its strength well under cold curing conditions. This mortar is placed at the head of the list by the committee in their conclusions.

Tensile Strength

No masonry structure can be designed to eliminate all eccentric loading. Such loading throws one side of the wall into compression and the other side into tension, and so the mortar is called upon to resist a certain amount, comparatively small, of tensile stress. Even in the best designs it is impossible to use sufficient tension members to entirely relieve the mortar of some tensile stress. The lime-cement mortars show ample tensile strength to resist all tension that may occur in a properly designed wall.

It is interesting to note that the lime-cement specimens all showed increases in strength in cold storage as compared to warm storage. This may probably be accounted for by the fact that the air in the cold storage chamber held more moisture than was present during the warm storage period. This additional moisture may have aided in the hydration of the portland cement and thus increased the strength.

Mortar E practically doubled in strength in cold storage, having a greater relative increase than any other mix. This indicates that it is particularly suitable for cold weather work, for not only does it have the necessary strength but also it is highly plastic and easy to handle even when the workmen's hands are cold and stiff.

Compressive Strength

The compressive strength of mortar is ordinarily thought of as being the most important. It is most essential, but it should

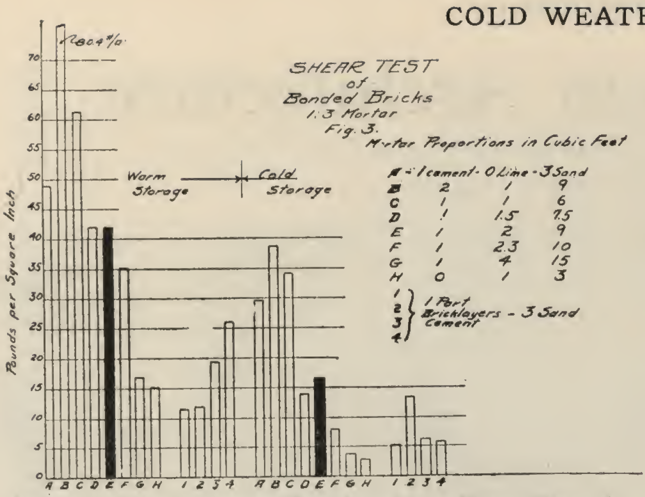


Fig. 3. Chart Showing Results of the Shear Test of Bonded Brick.

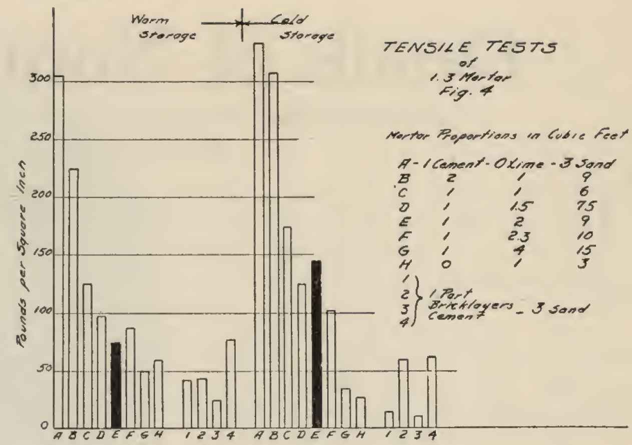


Fig. 4. Chart Showing Results of the Tensile Tests of 1.3 Mortar.

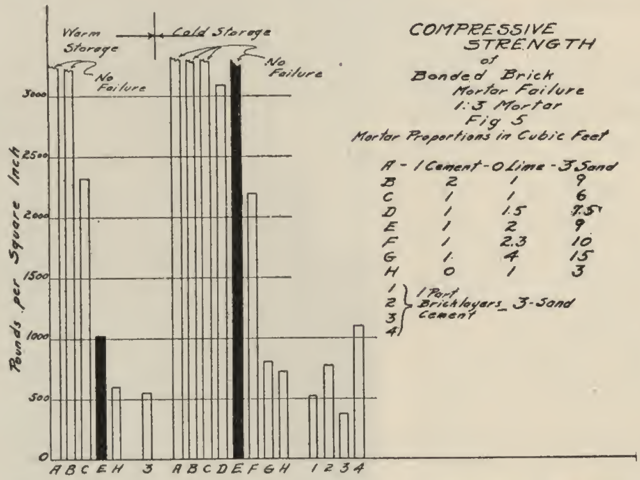


Fig. 5. Chart Showing Results of Compressive Strength Tests of Bonded Brick.

be considered in relation to the loading of the wall. If the load on a wall was uniformly distributed and centered, compressive strength would be sufficient. However, if any eccentricity is introduced, as must necessarily be because of the fact that the floor beams are only set into the wall, the stability of the wall depends upon the shear and tensile strength of the mortar as well as its compressive strength.

Cold weather did not decrease the 28-day compressive strength of any of the specimens containing lime. In fact, all the specimens in the lime-cement series showed increases. This may be accounted for by the presence of more moisture in the air during cold storage.

Two of the lime-cement specimens exceeded the power of the testing machine in warm storage, and four of them could not be broken after cold storage for the same reason. Mortar E showed an increase in strength of over 300 per cent in cold storage, just as in the tensile strength test.

Conclusions of Committee

1. With all cements save one, freezing decreased the bond strength of the mortar to the brick. In most cases this decrease was very marked. In the exceptional case, where there was no apparent injury due to freezing, the bond strength after curing in warm or in freezing temperatures was very low.

2. Curing at low temperatures just above the freezing point of water adversely affected the bond strength to a less extent than curing under freezing temperatures.

3. Basing judgment on the unit stress at flaking of mortar, it appears that curing at temperatures near the freezing point had little effect on the crushing strength of the mortar in the bonded brick. On the other hand, freezing appears to have had a weakening effect on the crushing strength.

4. From the above evidence it appears that freezing is detrimental to the strength of mortars which are commonly used in bricklaying.

5. From the standpoint of strength the following mortars gave the best results:

1 vol. of Port. cement to 2 vol. of hyd. lime to 9 vol. of sand.

1 vol. of Port. cement to 2 vol. hyd. lime to 9 vol. of sand.

1 vol. of Port. cement to 1 vol. of hyd. lime to 6 vol. of sand.

2 vol. of Port. cement to 1 vol. of hyd. lime to 9 vol. of sand.

1 vol. of Port. cement to 2.3 vol. of Q. lime paste to 6.7 vol. sand.

1 vol. of Port. cement to 2.3 vol. of Q. lime paste to 10 vol. sand.

1 vol. of Port. cement to 1.5 vol. of Q. lime paste to 5 vol. sand.

1 vol. of Port. cement to 1.5 vol. of Q. lime paste to 7.5 vol. sand.

1 vol. of Port. cement to 3 vol. of sand.

Of these mixes those containing 1 volume of cement to 2 volumes of lime (hydrate or paste) to 9 volumes of sand are the most economical. Mixes containing equal volumes of cement and hydrate (or paste) though somewhat more costly were stronger especially at one month.

6. Mixtures of lime and portland cement were much more plastic and easier to work than the mortar made with portland cement and sand. The mixtures containing equal parts of hydrated lime and portland cement and one part hydrated lime to two parts portland cement exhibited considerably higher adhesion to the brick than the portland cement mortar.

Actual Strength Requirements

All large modern structures now have frames of steel or reinforced concrete, economically designed to carry the loads. Brickwork in this type of construction is used only for facing or filling, for curtain or partition walls, and carries merely its own weight. Some structures, such as apartment house or mill construction, still have brick-bearing walls, but the actual load on the lowest mortar bed is usually under 100 pounds per square inch, a load easily carried by straight lime mortar.

All tests, as well as experience, show that lime mortar has plenty of strength for modern construction. The 1:2:9 mix (Mortar E) has an exceptional combination of advantages, and it is particularly good for use in cold weather. To require greater strength than that of this mix is equivalent to using steel beams where two-by-fours will carry the load.

Details of Norman Architecture

A Period Style Offering Many Possibilities for Distinctive Effects in the Designing of Modern Homes

THERE are many features of Norman architecture that are charming when adapted to the modern American home. Just because Norman architecture was once the style for lofty feudal castles in France, and later in England, is no reason why it cannot be suitably modified for domestic architecture. Indeed attractive small, but up-to-date, homes are borrowing much from this picturesque but pleasingly simple type and period. The farm houses of Normandy, too, prove that the castle tower and turret are both artistic and practical for the dwelling.

Because of the many towers flanking the plain walls, Norman architecture is aptly called "the circular architecture." This predominance of curves is one characteristic that makes it pleasing to the eye and harmonious with any rolling landscape, curved street or hillside building site. The conical roofs atop the towers and turrets are another noticeable characteristic, and one that is easily adapted to the smaller home. Often these smaller towers were sentry boxes on the castle moat, wall or battlement. The one in the illustration, flanking the entrance porch at the right, shows how a protective feature becomes a decorative one.

As many details of Norman architecture were built to make the dwelling a stronghold or fortress, this explains the massive effect that lends dignity even when applied on a small scale to our latest homes. Stout walls with loopholes for weapons, doors at ground level only and for soldiery, small windows, secret staircases and sturdy building materials made Norman architecture durable for battle and the succeeding centuries. Since the 11th century, when William the Conqueror brought Norman refinements to Saxon England, tall castles or chateaux with towers and plain walls have been the inspiration of architects.

The Little "Watch Tower" Flanking the Porch, the Dove Cote and Weather Vane Illustrate How Both the Norman Castle and Farm House Furnish Details to the Modern American Home.

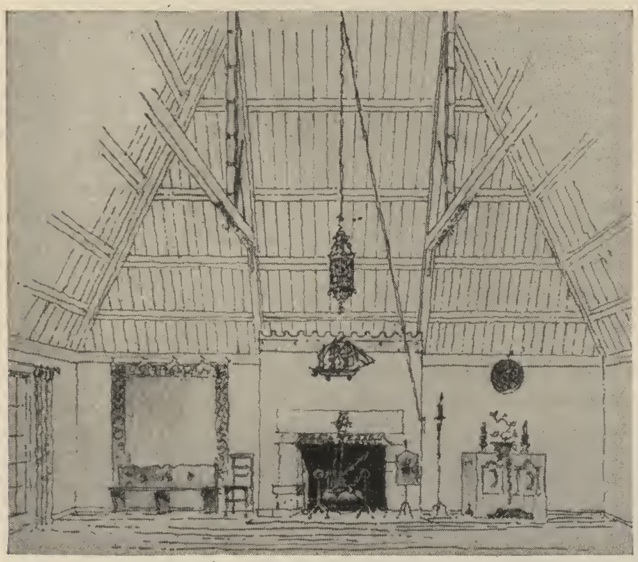
A Close-up Reveals the Charm of Texture in Building Materials and How Cleverly the Substantial Masonry of the Normans Has Been Simulated in Stucco and Rock.

Half timbering was applied later in the sixteenth century of Elizabethan England. But it frequently makes an interesting variation to modern petite Norman "castles." This is partly because manufactured stucco must be substituted for the sturdy native masonry of the Old World. Some clever effects, however are gained by resourceful modern architects by blending rockwork and stucco. The wall in the Hollywoodland, California, castle, shown in one of the illustrations, is noteworthy and is responsible for much of the solidity and dignity felt in the structure.

In this home, as well as in the others pictured here, locating the garage has been achieved in such a fashion as to make the doors have the old-time feudal aspect. Lighting fixtures of hand wrought iron emphasize this detail still further.

As the Norman castle inspired the peaceful French farmer of latter day for his manor house, the style took on other pastoral details. The dove cote especially and

This Norman Type Residence Keeps Faith with the Law of the Castle, with the Protecting Walls and the Garage Doors Built Like the Ancient Portcullis.



A Suggestion for the Norman Interior, by John S. De Lario, Architect. The cathedral ceiling timbered instead of plastered and the battlement above the fireplace are noteworthy details.

the weather vane have a rural charm that the modern city builder frankly borrows. Steeply pitched roofs were as practical for the long warm summers of southern France as for the snows of England and America. Farm house roofs were thus pitched and thatched or later shingled and the gay colors variegated by time. Casement windows with small mullioned panes are almost invariable.

Within the castle wall, the Normans employed vaulted or "cathedral" ceilings, barren of plaster, but vigorous in beams and carving. The modern builder wisely used this relief for the austerity of neutral plaster walls. But wall hangings are an equal opportunity for the decorative touch. Simple fireplaces, not hooded until the very last of the period, and then copied from Italy, enlivened the combination living and banquet hall. The battlement treatment above the fireplace, seen in the interior sketch, is as harmonious for a Norman period interior as the simple bench to the left. But probably most characteristic, and yet practical for the modern home, is the circular staircase. This fills in the tower with its conical roof, giving it a raison d'etre. It may be built of iron or wood, or have cement treads. Some of these homes illustrated have "secret staircases" that open from the street and lead directly to the second story where dining, living or bedroom may be found, according to the view, which has influenced the floor plan. In addition, a circular staircase, visible, leads from the main hall. Sometimes the entrance hall, however, is little more than a tiled vestibule.

Comfort, with picturesque period effect, is the ideal for an up-to-date home with Norman architecture adapted to it, no matter how large or how small.

Proper Tools for Economical Work

THE importance of having sharp tools on the job is hard to estimate. In the first place good work with poor tools is impossible; in the second place, the production is greatly reduced. Then there is not only the wear and tear on the man who uses poor tools but the effect that it has on the whole gang.

The tools that the employer himself finishes should always be in the best of condition. There is, perhaps, nothing that will produce carelessness so surely as rundown tools furnished by the boss. Not enough or poorly chosen tools is another thing the employer should avoid. The money saved by the contractor by not furnishing the necessary equipment for a job represents about 25 percent of the amount that he loses by the practice.

This Chateaux, at Hollywoodlands, California, Illustrates Both the Solidity and the Semi-circular Characteristics of Norman Architecture, from Which It Has Been Adapted.

More "Elbow Room" in the House

Innovations in Attic and Basement Add to the Desirability of a House

EXTRAS add to the desirability of a house. Anyone may have a living room, a bedroom, or dining room, or kitchen, but a home ball room, billiard room or play room for the youngsters, are supposedly reserved for the fortunate and few.

A house of modest price possessing one of these features becomes by virtue of it a thing above the common run. Yet so easily are additional rooms constructed, even in houses long since erected, that every one who boasts a home may enjoy it, plus special additions.

The third floor of the average house can be made into a "party room," for instance. All partitions should be torn out, a new floor laid and a plain, inexpensive fireplace built. Sheets of wall board can be nailed to the walls and ceiling and painted with flat wall paint. If all

Here Is an Attic Which Has Been Converted Into a Family Ballroom with Flooring, Wall Board and Paint.

the woodwork is painted or varnished and the floor stained and varnished the attic will be converted into a practical, attractive dance hall where the children may entertain.

Remodeling the attic in this way practically saves its cost in fuel. Wall board is an insulator and will reduce the great loss of heat through the roof. The new floor, painted and varnished, will further stop warm air leaks.

The attic also provides for a large, unrestricted play room for the youngsters. Wall board and paint contrive to make the raftered "garret" a pleasant room for the children where they can indulge in their liveliest games without

A Tasteful Use of Wall Board Panels, Paint and Varnish Results in an Excellent Basement Billiard Room.

fear of damaging the furniture.

Extra bedrooms, work rooms, dens, and billiard rooms can be inexpensively constructed. What they add to the comfort, charm and desirability of a house can scarcely be estimated.

The attic, however, is not the only "waste space" which can be recalled to use. The basement—that portion usually held sacred to furnaces, laundries, and coal-bins—can be made over into an "additional room." Radio rooms and billiard rooms are basement favorites.

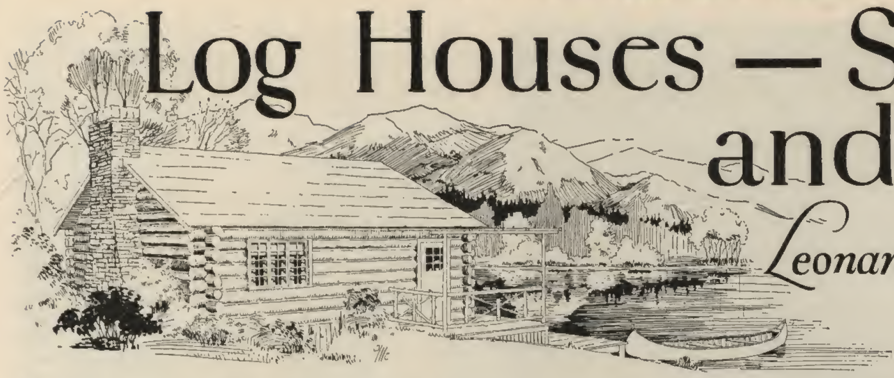
Wall board can be used to partition off a section of the cellar. Decoration is, of course, one of the principal problems in any basement remodeling. It may be solved by using the new plastic material that gives texture and tone. If the surface is glazed and sized it will be made washable. The cement floor should be painted, too, with special paints.

The builder who is awake to the possibilities of making "luxury" rooms out of "waste space" makes himself available for all sorts of innovations and renovations.

New houses, containing such rooms, become more desirable; old houses, when renovations of this sort have been introduced, find their value increased.

A Bright, Clean, Attractive Play Room Can Be Made in the Attic with Wall Board. A private play room for the youngsters is decidedly attractive to the head of the family.

A Quiet "Home Work Room" for the Children or Reading Room for Their Elders Is Another Attic Innovation Which Many Householders Will Find Attractive.



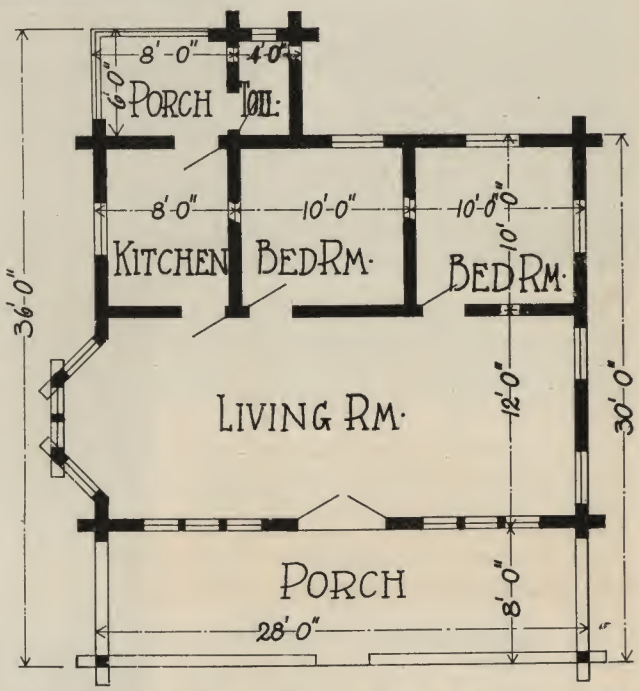
Log Houses—Summer and Winter

By Leonard C. Vecelius

I WAS quite elated to find that my interest in log construction was shared by the editors of AMERICAN BUILDER and that an article on the subject was considered worth publishing. I hope that my experience may prove helpful to others interested in building this type of summer home which, when properly constructed, affords a great amount of satisfaction to the owner.

Up until comparatively recent years the idea that a great many people had of a summer home seemed to be that it was a place to go for a regular rough house, that is a place so constructed and maintained that it did not matter how roughly it was used. All the old, cast-off furniture that we, or our friends had, was considered good enough and comfort was not expected. The place was used merely for a few week ends and perhaps for the two weeks when we had our summer vacation. If we paid $100 for the lot and $300 or $400 for the materials and had our friends help nail the place together, we considered ourselves well fixed for a summer home. But ideas on this subject seem to have changed along with a great many others.

About five years ago, while traveling through the country, I occasionally saw an old log cabin, some 50 or 75 years old, which was still in fairly good shape. The thought occurred to me that log structures, with modern designs and comforts, ought to be attractive not only as summer homes but as permanent homes as well. I drew plans and built some cabins. They took well with the public and every prospective buyer would give me new ideas, both on



For the Average Family a Log House Built from This Plan Is Entirely Practical and Will Make the Summer Vacation a Time of Real Pleasure.

The Small Summer Home of Logs May Be Attractive in Appearance, Full of Comfort and Yet Inexpensive in Cost, in Fact Log Construction Permits Practically Any Sort of a House that Is Possible with Other Building Materials.

Log Houses Are Not Always Restricted to Summer Use. They may be made as attractive within as any other type and are easily heated.

design, rustic finish and construction.

As I progressed I found the log cabin could be built and utilized for a year around dwelling. The people who now own cabins I have built use them, not only during the summer months, but practically every week end throughout the winter months and also as permanent homes. Inside of half an hour these houses can be heated, after being cold for the entire previous week, and made as warm and comfortable as one could wish.

When asked to submit plan and specifications for a log house, I much prefer to see the prospective site first as the proper design for the site means everything in making the place suitable for the surrounding landscape. The desirability of this can be appreciated quite readily when you see the various designs of cabins which have been adapted to specific sites.

The foundation for a log house is very important. This is obvious when you stop to figure the weight of the logs used. Say a log 9 inches at the butt, running 40 feet long and tapering to 4 inches at the top weighs approximately 600 pounds. The average six rooms and bath cabin takes about 190 logs and the total weight would be 57 tons for the logs alone.

I have tried all kinds of timber such as cedar, pine, ash, elm, oak, maple, tamarack and poplar and I find poplar makes the best logs for all purposes. Poplar does not shrink nor check if treated, as soon as peeled, with an oil stain filler. It dries out quite readily and becomes very hard and

Dead Rafters Which Equalize the Gables of the Various Rooms Also Provide an Excellent Insulating Air Chamber Above.

An Enclosed Porch Adds Greatly to the Enjoyment of the House Whether It Be Used as a Summer Cottage or as a Year Around Dwelling.

light. It takes the varnish well, giving a very glossy finish.

I always use dead rafters to give all rooms an equal gable and in doing this provide air chambers above the ceilings which gives better insulation. I use fiber wallboard and quarter-sawed logs for ceilings. The wallboard is finished by using sponges to apply different colors of either stain or paint.

In laying the logs they must be laid as close together as possible, in fact close enough to use a ¾-inch trowel to apply the chinking. I chink with a mixture of lime, cement and sand. As the logs are laid up they are fastened together with No. 60 spikes. We bore a 1-inch hole half way through the log on the top side and drive the spike in this and down into the

Even a Tiny House Like This May Be Made Attractive and Provide a Summer Cottage Which Offers Plenty of Comfort and a Distinctive Charm. The cost of log construction is less than for frame construction from the same plans, and when properly built the log house is one of the most comfortable and satisfactory types of dwelling that has ever been devised.

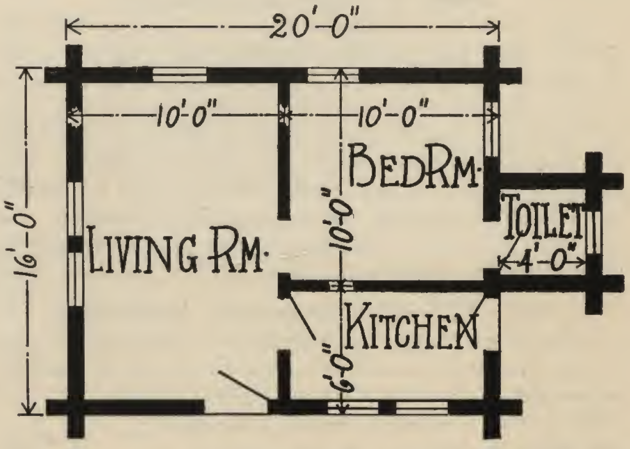
log below, which keeps all the shift out of the walls. These spikes are placed every 4 feet and they are staggered from log to log.

After the chinking is thoroughly dry, I cover the chinking, and lap over about ¼ inch onto the log, with a plastic gum which comes in various colors. This gives and takes the settling of the logs and holds the chinking intact indefinitely.

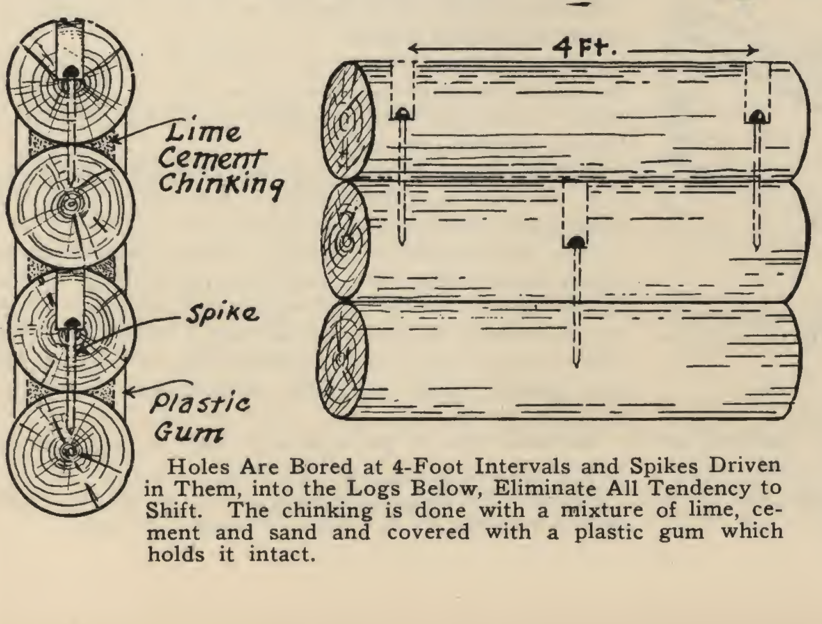
I find that any good, hot air furnace, with a 24-inch fire pot, will heat a cabin as large as 48 feet by 54 feet, using about nine tons of soft coal a year. I have one cabin that is 52 feet by 64 feet, with 56 windows measuring 22 inches by 24 inches, that is heated with an Arcola heater with very good results.

All door and window frames, screens and rafters are cut at our warehouse and taken to the job. The logs are cut in lengths of from 12 to 20 feet in the woods, trucked to the job and then sawed to length by power saws. When we use logs for window and door frames, they are taken to the warehouse and slabbed for the jambs and window tops. The sub-floors and partitions are built in before the roof is put on to tie the outside walls.

Our furniture department builds all kinds of log furniture, including lighting fixtures and lamps. We build anything in the line of buffets, china closets, cellarettes, dining tables and writing desks, to the customer's order as to style and dimensions. Some of the rustic pieces are shown in the illustrations.



A Living Room, Bedroom, Kitchen and Toilet, Within These 16 by 20-foot Walls, Offer as Much as the Modern Kitchenette Apartment.



Holes Are Bored at 4-Foot Intervals and Spikes Driven in Them, into the Logs Below, Eliminate All Tendency to Shift. The chinking is done with a mixture of lime, cement and sand and covered with a plastic gum which holds it intact.

The A B C of Roof Framing

DURING the last few years the writer has received numerous requests for information regarding roof framing and the steel square. From these requests it is evident that there are three important points on which information is lacking. These three points will be enumerated and discussed in this chapter.

Point "A"—The Essential Knowledge

Many requests read about as follows: "Tell me all about the steel square"—or "I would like to know more about the steel square."

The general impression seems to be that there is some mysterious thing about the steel square that if a person knows it he will be able to do any kind of roof framing. Perhaps it works like a slot machine, put in the coin and out comes the information.

It is true that the steel square is a wonderful tool but it is also true that the usefulness of the steel square is based on very simple mathematical rules, and therefore what the carpenter needs first of all is a knowledge of the principles of roof framing. Perhaps it would be even more to the point to say that the carpenter needs to understand the mathematical principles by which the framing of roofs is figured.

The steel square will lose much of its mystery if we understand *arithmetic*. The purpose of these articles has been and will be to teach the *why* of the methods and rules of roof framing and not simply to give a set of so-called rules and short cuts. The man that understands the principles will develop his own rules and methods.

Point "B"—The Best Method

Other letters and requests have brought the idea that there should be one best method of obtaining the lengths and cuts of rafters. Many, too, believe that their particular method is the only one that is of any use. I would answer these that the important thing is to learn the principles of roof framing and then develop the methods that are best suited for their particular work. In these articles different ways or methods of arriving at solutions will be given and explained. Get the good points in favor of each and you will benefit by them. The best methods are those that best suit your needs.

Point "C"—The Elementary Knowledge

In many cases where information on some technical point of roof framing is wanted it is found that the one does not understand clearly the first principles of roof framing; that is, does not clearly understand the *pitch of a roof*.

Take, for example, the question: "What is the rise per foot run of a three-fourths pitch roof?" Many will argue that it is 9 inches per foot run. (Try to answer this yourself.)

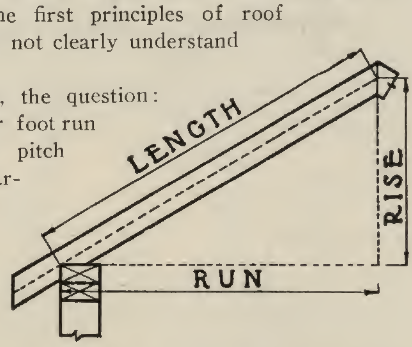


Fig. 2. By the "Run" Is Meant the Horizontal Distance Which the Rafter Covers.

The first, then, to learn is about the pitch of a roof. After this is thoroughly understood, a great deal of the difficulty in roof framing is removed. To explain this point we will give a list of questions and answers. These will be rather elementary to some readers, but to others they should give the knowledge that is so essential to an understanding of our subject.

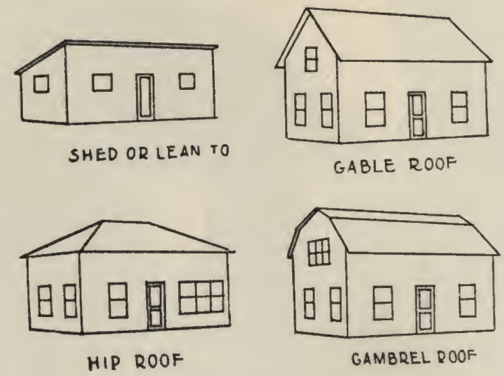


Fig. 1. Four Types of Roof Commonly Used in Residence Construction Work Are the Shed or Lean-to, Gable, Hip and Gambrel.

Questions and Answers on Roof Framing

Question—What is meant by the "pitch" of a roof?

Answer—By the "pitch" of a roof we mean the grade or degree of slope of the roof.

Question—By what method is the "pitch" of a roof given or described?

Answer—There are several ways. One method is to compare the total height of the roof by the width of the building. This method of giving the pitch of the roof we may assume was adopted and used by early builders before accurate methods of figuring roofs were ever thought of. It may have been used to describe the pitch or slope of tents and huts. To explain this method of indicating the pitch of a building let us assume that we had a building 18 feet wide and the height of the roof was 9 feet above the side wall. This roof would be half as high as it is wide and would be called a half pitch roof.

If we have a building 18 feet wide and 6 feet high from the top of the side wall to the top of the roof, we would call it a one-third pitch roof, because it is one-third as high as it is wide.

The width of the building or roof is usually called the "span" and the height from the top of the plate to the ridge is called the "rise."

To get the pitch of the roof, we divide the height by the width, or, as usually stated, "divide the rise by the span." In the first example, the rise is 9 feet and the span 18; 9 is $\frac{1}{2}$ of 18, or $9/18 = \frac{1}{2}$. The pitch is $\frac{1}{2}$.

Question—What other method is there of describing or stating the pitch of a roof?

Answer—Another method now commonly used is to state the rise of the rafter per foot of run. By the "run" of the rafter we mean the horizontal distance that the rafter covers. This is illustrated in Fig. 2.

By this method we say a roof has an 8-inch rise per foot run, or a roof has a 9-inch rise per foot run. In Fig. 3 we indicate the various pitches in this way.

Take, for example, the rafters shown in this illustration having a 6-foot rise. The building is 18 feet wide, but one rafter only covers a horizontal distance of 9 feet, therefore the run of the rafter is 9 feet and the rise is 6 feet. For every foot of run the rise would be 1/9 of 6 feet or 6 feet divided by 9 equals 2/3 foot, or 8 inches. This rafter, therefore, has an 8-inch rise per foot run.

Question—What is the pitch of a roof 18 feet wide and 3 feet high, expressing it in both ways?

Answer—The pitch expressed as a ratio of the rise to the span is 3 divided by 18 equals 3/18 equals 1/6 pitch.

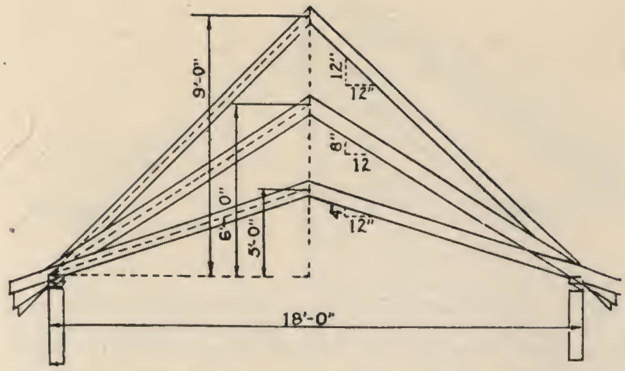


Fig. 3. How Roofs of the Same Width May Have Different Pitches, Depending Upon the Height of the Roof.

The pitch expressed as the rise per foot run is found by dividing 3 feet or 36 inches by 9, because the run is 9 feet. Thirty-six inches divided by 9 equals 4, therefore the rise per foot run is 4 inches. This is illustrated by the lower set of rafters in Fig. 3.

Question—What would be the rise per foot run for a one-half pitch?

Answer—For a one-half pitch the rise is one-half of the span and as the run is one-half of the span, therefore the rise would equal the run, or, in other words, for every foot of run we would have one foot of rise. A one-half pitch roof has a 12-inch rise per foot run.

Question—What would be the pitch (expressed as a ratio of the rise to the span) of a roof that has a 9-inch rise per foot run?

Answer—If the rise is 9 inches per foot run then the total rise of the roof is 9/12 of the total run or 9/24 of the total span because the span is twice as much as the rise. The pitch, therefore is 9/24 or ⅜.

Problems

1. A lean-to roof has a run of 10 feet and a rise of 2½ feet. What is the rise per foot run?
2. A roof for a building 28 feet wide is to have a one-fourth pitch roof. What is the total rise?
3. What is the rise per foot of a three-eighths pitch roof?
4. A roof 36 feet wide has a rise per foot run of 8 inches. What is the total rise?
5. What is the pitch of a roof 24 feet wide and 11 feet high?

Answers

1. If the total rise is 2½ feet and the total run is 10 feet, then the rise of 1 foot of run is 2½ feet divided by 10; 2½ feet is equal to 30 inches.

$$\text{Therefore } \textit{rise per foot run} = \frac{30}{10} = 3 \text{ inches}$$

2. If the building is 2 feet wide and one-fourth pitch, then the total rise is ¼ of 38 equals 7 feet.

3. In a three-eighths pitch roof the rise is three-eighths of the span and as the run is one-half of the span, then the rise is three-fourths of the run. If the total rise is three-fourths of the total run, then the rise per foot run is also three-fourths of 1 foot. Three-fourths of 12 is 9, therefore the rise per foot run is 9 inches.

4. The building is 36 feet wide or has a run of 18 feet. The rise per foot run is 8 inches. The total rise is 18 times 8 equals 144 inches equals 12 feet.

5. The pitch of a roof 24 feet wide and 11 feet high is 11/24. The rise is 11 inches per foot run.

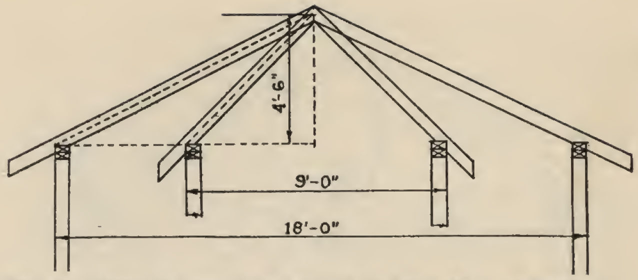


Fig. 4. How Roofs of the Same Height May Have Different Pitches, Depending Upon the Width of the Roof.

Another Fundamental Point in Roof Framing

In the preceding section we emphasized the fact that it was important to correctly understand the method of expressing the pitch of a roof. After we understand this part, then we naturally want to know the next step. This is finding the length of the rafter. In this case, too, we shall try to go into the "Why" of the rules, or methods. If we once understand the mathematical reasoning that is used to figure the length of rafters, then we can figure most any kind without many rules.

The Master Key

Let us now observe Fig. 5 closely. We find that the rise of the rafter makes an angle of 90 degrees with the run of the rafter, or, in the usual way of stating this, "a right angle." Let us also note that the rise, the run and the rafter itself form a triangle.

This triangle is a right triangle.

Let us next study Fig. 7. Here we have an illustration of an irregular shaped roof. With dotted lines we have indicated a number of right triangles. We find that in each case the rafter together with its run and its rise forms a right triangle. What, then, is the great thing in roof framing? The right triangle. This is the master key that unlocks all the combinations of troubles in roof framing. It gives the length of rafters. It gives the top and bottom cuts and it gives the bevels.

How the Master Key Gives Lengths

How, then, do we find the length of a rafter? We find that to get the length of a rafter the pitch must be given. This is part of the design.

If a building is 8 feet wide and has a ⅜ pitch, then the rise is ⅜ of 8 feet = 3 feet. The run is 4 feet.

The steel square is made in the form of a right angle—that is, the tongue and the blade make an angle of 90 degrees with each other. Therefore, we may use the steel square to find the length. In Fig. 6 a huge steel square is shown on the side of a rafter. The blade of the square takes the place of the run of the rafter and the tongue of the square takes the place of the rise. If we wish to find the length of a rafter we may take as many inches on the tongue of the square as there are feet in the rise of the rafter and as many inches on the blade of the square as there are feet in the run of the rafter. Then measure between the two points with a rule and the rule will give the length of the rafter. Each inch on the rule will stand for 1 foot length of rafter and each 1/12 of an inch on the rule will stand for 1 inch on the rafter.

The rafter in Fig. 5 has 4 feet for the run and 3 feet for the rise. This is shown on the square in Fig. 8. The length is found to be 5 inches on the square, therefore the length of the rafter would be 5 feet.

Try another example on your own square. Take the run of the rafter as 10 feet and the rise as 8 feet. The length of the rule will come out as 10 and 10/12 inches, therefore the rafter is 10-10/12 feet or 10 feet 10 inches.

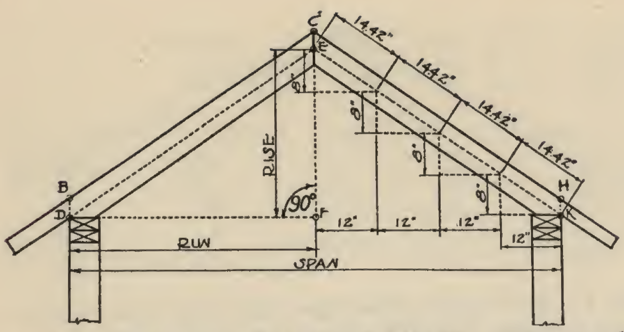


Fig. 5. The Rise of the Rafter Makes a Right Angle (90 Degrees) with the Run of the Rafter and the Rise, Run and Rafter Form a Triangle.

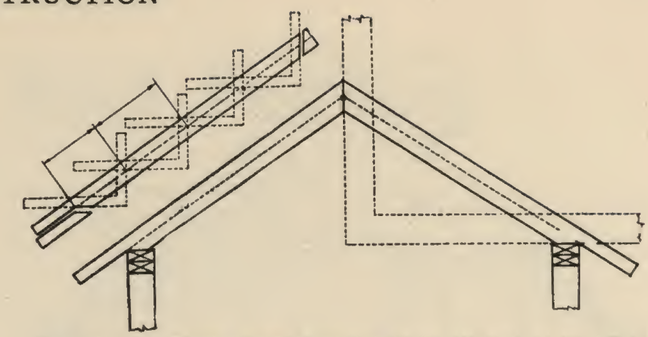


Fig. 6. If a Huge Steel Square Were Placed at the Side of the Rafter, the Blade of the Square Would Take the Place of the Run and the Tongue Would Take the Place of the Rise.

Square and rule should be divided into twelfths of an inch to make transposing from inches to feet easy.

The Mathematical Method

We may next study the lower part of Fig. 8. We have the same size triangle as in the upper part of this figure.

Let us count the little squares on each side. We find that the number of squares on the side A plus the number of squares on the side B are equal to the number of the squares on the side C thus: $A \times A = 9$; $B \times B = 16$; $9 + 16 = 25$, and this is the same as $C \times C = 25$.

Therefore, the square of the distance A plus the square of the distance B is equal to the square of the distance C thus:

$$A^2 + B^2 = C^2$$
$$(3 \times 3) + (4 \times 4) = 5 \times 5$$
$$9 + 16 = 25.$$

To find the length of C we take the square root of 25 = 5. The length of C = 5.

This same reasoning holds good on any right angle, and, therefore, we use this method for finding the length of rafters.

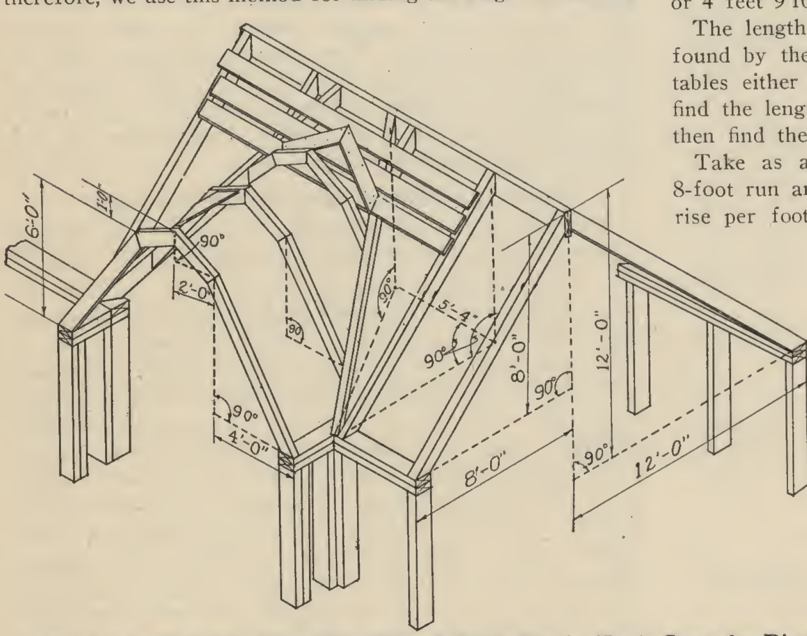


Fig. 7. Here Is an Irregular Shaped Roof But in Each Case the Rise and Run Form a Right Angle. The great thing in roof framing then is the right angle.

The square of the run plus the square of the rise is equal to the square of the length.

Take the rafter in Fig. 7 that has a run of 4 feet and a rise of 6 feet.

$$Run^2 + Rise^2 = Length^2$$
$$4^2 + 6^2 = Length^2$$
$$16 + 36 = 52.$$

If 52 is the square of the length, then the length is the square root of $52 = 7.21 = 7$ feet $2\frac{1}{2}$ inches.

Generally the rule is given as follows:

Length of Rafter = Square Root of $(Run^2 + Rise^2)$

This method does not appeal to carpenters in general because it involves square root. It, however, has several advantages. It is very accurate; it does not require a set of tables nor even a square; it works on any kind of rafter such as hips for uneven pitched roofs and the like.

Length Per Foot Run

Next let us study Fig. 5 again, especially the right hand side. Here we have four small triangles in place of one large one as on the left side. We have formed a triangle for each foot of run. It is clear that if we find the length of tne rafter for one of these small triangles that we can find the total length of the rafter by multiplying by the total number of divisions.

In Fig. 5 the length of rafter for one foot run is 14.42 inches and there are 4 feet in the run; therefore, the total length is 4×14.42 inches = 57.68 inches = 4 feet 9.68 inches or 4 feet 9 10/16 inches.

The length per foot run for the different pitches may be found by the square root method, but is generally given in tables either on the square or in books. When we wish to find the length of a certain rafter we look at the pitch and then find the length per foot run from the table.

Take as an example, the rafter in Fig. 7 that has an 8-foot run and an 8-foot rise. This is ½ pitch or 12 inches rise per foot run.

From any standard square or table, we find that the length per foot run for this pitch is 16.97 inches.

As the run of this rafter is 8 feet the total length will be $8 \times 16.97 = 135.76$ or 11 feet 3¾ inches.

Stepping Off with the Square

On the right hand side of Fig. 6, we show how we may step off the length of the rafter with the square. The square is applied as many times as there are feet in the run. The figures on the square to be used are the rise per foot run on the tongue and a foot run or 12 inches on the blade of the steel square.

Problems

The roof illustrated in Fig. 7 is perhaps somewhat out of the ordinary. It is drawn in this manner for the purposes of illustrating the points discussed in the lesson. The following problems are based on Fig. 7:

1. What is the pitch of the upper part of the gambrel roof shown in Fig. 7?

2. What is the rise per foot run of this rafter?

3. What is the length of this rafter? Measure this length on the square.

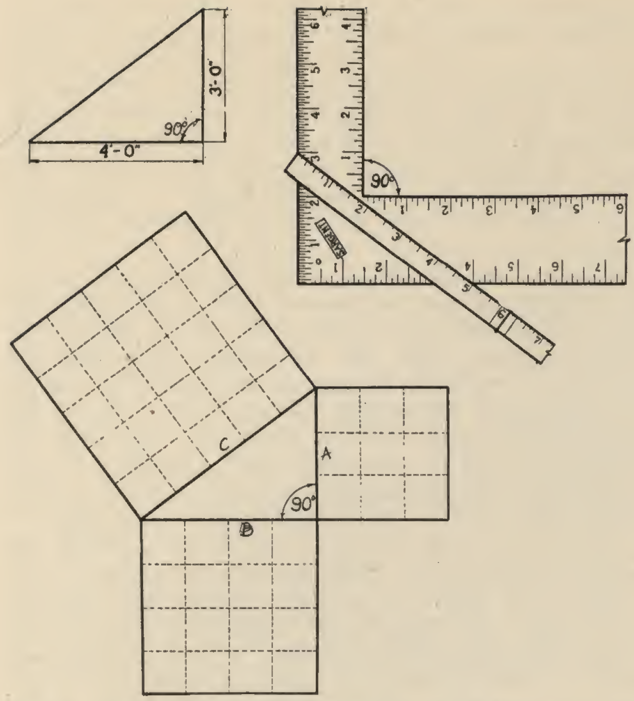


Fig. 8. **Here Is Shown in Diagram the Relation of the Rise and Run to the Length of the Rafter.**

4. What angle does the blade of the steel square make with the tongue?

5. What length is the run on the valley rafter? Use square root.

6. What is the length of the valley rafter?

7. What is the pitch of the lower part of the gambrel roof shown in Fig. 7?

8. One of the rafters in the illustration has a run of 8 feet. If the length per foot run is given as 16.97 inches on the steel square, what would be the length of this rafter?

9. If the method of applying the square as shown in Fig. 6 (upper right-hand corner) was to be used for finding the length of the rafter in problem 8, what number would be used on the square?

10. How many times would the square have to be applied to find the length of this rafter?

Answers to Problems

1. The run for this rafter is 2 feet. This makes the span 4 feet. The rise is 1 foot. The pitch is equal to $\frac{\text{Rise}}{\text{Span}} = \frac{1}{4}$.

2. The rise in 2 feet = 12 inches. The rise in 1 foot = $12 \div 2 = 6$ inches.

3. The length of this rafter is 2 feet 2 13/16 inches.

4. The blade of the steel square makes an angle of 90 degrees with the tongue.

5. The run of the valley rafter is the square root of $5.33^2 + 8^2 = 9.613 = 9$ feet 7 11/32 inches

6. The length of the valley rafter is the square root of $9.613^2 + 8^2 = 12.563$ feet = 12 feet 7¾ inches.

7. The total rise is 6 feet and the run is 4 feet. If the rise is 6 feet or 72 inches in 4 feet then the rise per foot is $72 \div 4 = 18$ inches. This is ¾ pitch.

8. The length of the rafter, if the run is 8 feet and the length per foot run 16.97 inches, will be 8×16.97 inches = 135.76 inches = 11 feet 3¾ inches.

9. The numbers used on the square would be 12 and 12 as this rafter has a 12-inch rise per foot run.

10. The square would be applied 8 times as the run is 8 feet.

Cutting the Common Rafter

We discussed the various methods of finding the lengths of rafters in our last lesson. Obtaining the cuts for the rafters is closely related to finding the lengths. We will find that very often the methods employed to find the length of a rafter will also give us the cut.

The cut at the upper end of the rafter is referred to as the TOP CUT, PLUMB CUT, VERTICAL CUT or RIDGE CUT. The cut at the lower end may be referred to as the SEAT CUT, HORIZONTAL CUT or BOTTOM CUT. The bottom cut sometimes requires both a horizontal and also a vertical cut as shown in Fig. 11. This is called a bird's-mouth.

If we carefully examine the top cut and the seat cut we find that the top cut of the rafter coincides with a line straight down or vertical and that the bottom cut coincides with a horizontal line, also that the two lines form a right angle where they meet. We, therefore, learn one thing, "The top and seat cut of the common rafter are always at right angles to each other." This makes it convenient to use the square.

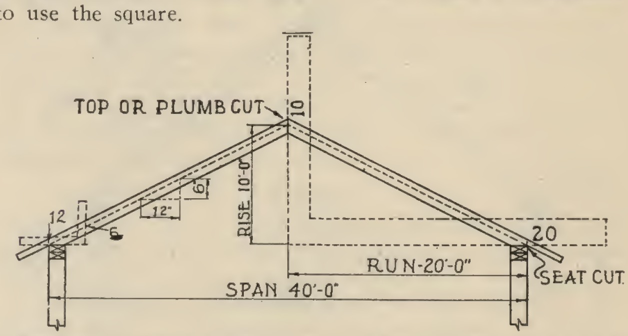


Fig. 9. Imagine a Huge Square Placed Along the Side of a Rafter to See How the Top and Bottom Cuts Are Obtained.

If we assume a huge square placed alongside of the rafter as shown in Fig. 9, we see that the edge of the tongue coincides with the top cut of the rafter, and the edge of the blade coincides with the bottom cut. If the square were marked in feet it would show the total run of the rafter on the blade and the total rise of the rafter on the tongue.

This gives us one method of laying out the cuts for the common rafter. In place of the feet on this large square we use inches on the regular square. To lay out the cut for the rafter shown we would take the No. 20 on the

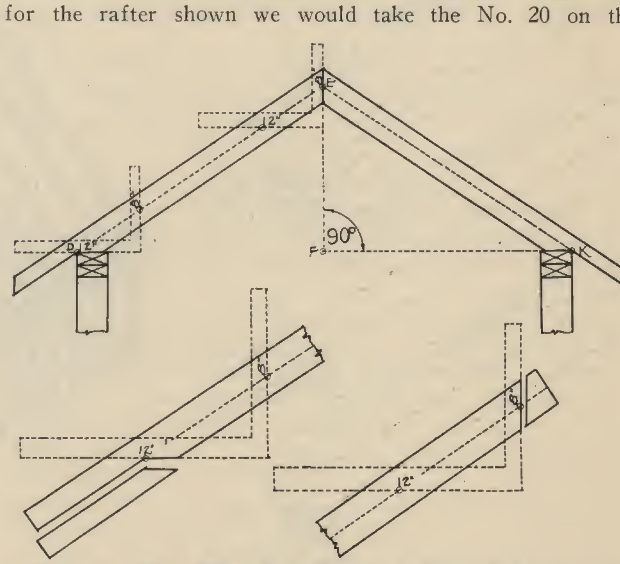


Fig. 10. The Rise Per Foot of Run, Taken on the Tongue, and 12 Inches on the Blade, Give the Top and Bottom Cuts for the Common Rafter.

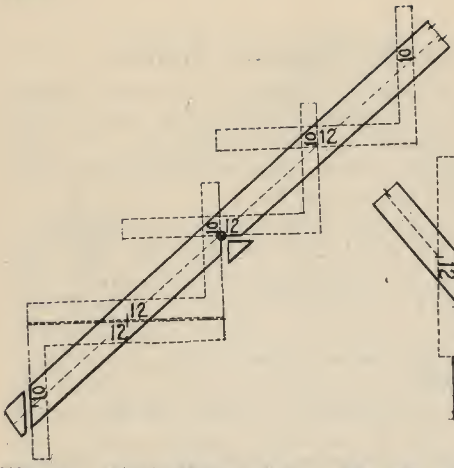


Fig. 11. Bird's-Mouth Cut, Method of Laying Out This Cut and the Tail of the Rafter.

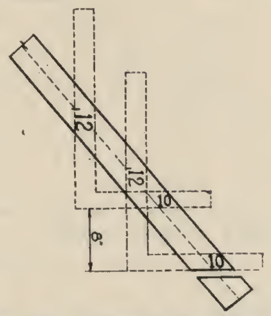


Fig. 12. How a fractional part of a foot in the run may be laid out in finding the length of the rafter.

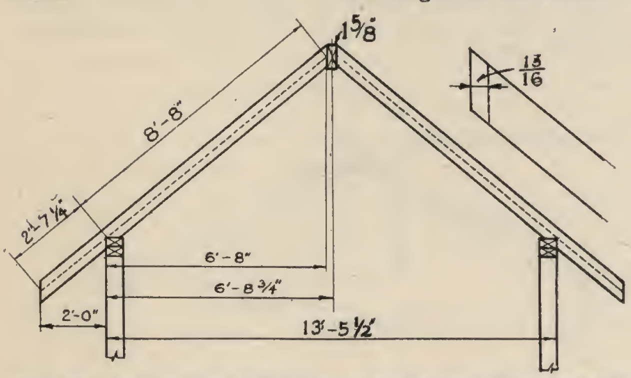


Fig. 13. A rafter problem where the span is in uneven

blade of the square, and the No. 10 on the tongue of the square. The square must then be laid on the board so that the 20 and 10 come on the edge of the board or on the measuring line as shown in the illustrations.

The question has been repeatedly asked, why use the measuring line and not the back or upper edge of the rafter? We may use either one, if we understand how to measure. By observing or studying the several illustrations given herewith we see that the edge of the plate, from which we generally calculate, is not on the upper edge of the rafter in most cases. Therefore, the length of the rafter obtained when figuring by the different methods is not along the edge of the rafter but along a line which passes through the point on the edge of the plate. In studying roof framing it is, therefore, best to make this point clear, so that error as shown in Fig. 14 may not happen. A beginner is apt to make this error if he does not understand this point clearly.

We have now learned one method of laying out the top and bottom cut for the common rafter. Expressing this in a rule, we may say, to lay out the top and bottom cuts for the common rafter take the numbers representing the total run of the rafter in feet on the blade of the square and the number representing the total rise in feet on the tongue of the square. For the bottom cut mark along the blade and for the top cut mark along the tongue.

The larger arm of the square is called the blade or body of the square and the smaller arm is called the tongue.

We will next study the little square on the left-hand side of Fig. 9 and Fig. 10. Here the square is placed so that 1 foot or 12 inches on the blade coincides with the edge of the plate. The blade of the square then covers 1 foot of run of the rafter and the tongue, of course, must show the rise of the rafter for 1 foot. As the edge of the blade now coincides with the bottom or horizontal cut of the rafter it gives us another method of obtaining this cut, that is, take 12 inches on the blade and the rise per foot run on the tongue and lay the square on the board with these numbers on the measuring line or on the back of the rafter, marking along the blade of the square.

We have previously learned that the top cut is at right angles to the bottom cut, therefore the tongue of the square being at right angles to the blade must give the angle for the top cut. Therefore, the square with these same numbers applied to the upper end of the rafter will give the top cut.

In Fig 10 we have a rafter with a rise of 8 inches per foot run. To lay out the top and bottom cuts we use 12 inches on the blade and 8 inches on the tongue. The lower left hand sketch shows how the bottom cut is laid out and the lower right shows the application for the top cut. Note the same numbers are used for the top and bottom cut.

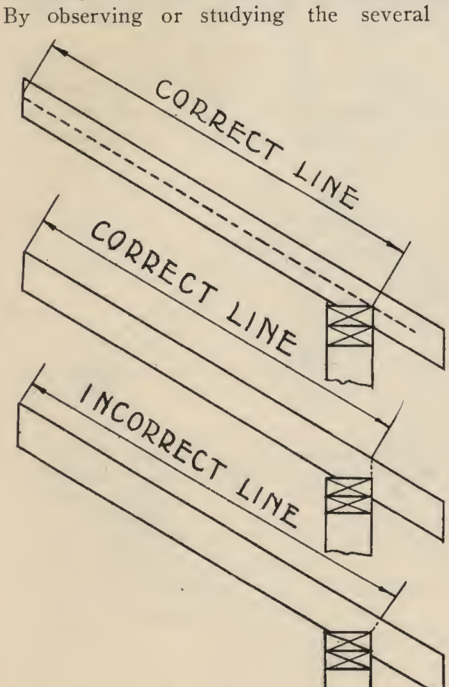


Fig. 14. Correct and Incorrect Method of Laying Out the Length of a Rafter.

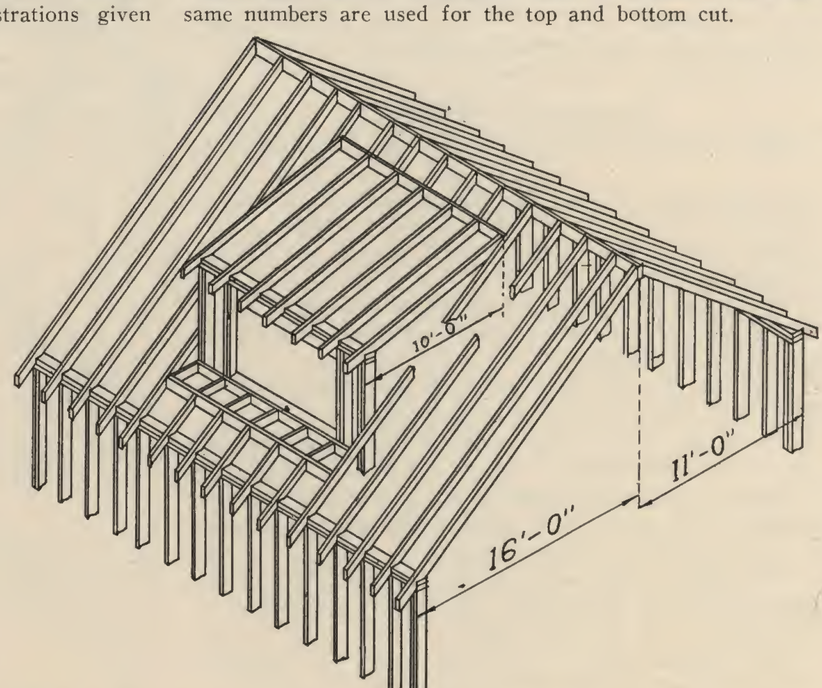


Fig. 15. Final Problem for This Lesson. Find the lengths of each rafter and give the numbers on the square which give the cuts.

The rafter illustrated in Fig. 13 presents a good problem to further illustrate some of the things that we have learned in this and the preceding lessons.

This rafter is drawn to have a 10-inch rise per foot run. For every foot of run we have 2 feet of span—that is, the span is twice the run. The proportion of the rise to the span, therefore, is 10 inches to 24 inches, or 2 feet. The pitch is rise ÷ span = 10/24 = 5/12. A 5/12 pitch corresponds to a 10-inch rise per foot run.

As the rise is 10 inches per foot run we use 12 and 10 on the square to obtain the cuts. Fig. 11 shows how the bird's-mouth cut at the seat is laid out. The overhang is 2 feet wide; therefore, the square is applied twice to get the length of this overhang. This figure also illustrates how the square is applied to get the length of the rafter. Beginning at the seat cut the square must be applied six times for the 6 feet of run. This leaves a fraction of a foot (8 inches). This is taken care of by applying the square as shown in Fig. 12. In this case we have subtracted the thickness of the ridgeboard from the run (dropping one-sixteenth of an inch).

If the total run is an even number of feet it may be just as simple to calculate the length of the rafter to the center of the ridgeboard, mark the top cut, and then subtract for the ridgeboard by measuring back thirteen-sixteenths of an inch, which is one-half the thickness of the ridgeboard. This is shown in the little sketch in Fig. 13.

Problems

Fig. 15 illustrates a type of roof very common today. The problems of this lesson will be based on this roof.

Note that the plates are not at even height. This puts the ridge of the roof to one side of the center. The total span is 27 feet. The rafter on the rear side has a run of 11 feet and the front rafter has a run of 16 feet. These rafters have the same pitch. The pitch is one-third, making the rise, per foot run, 8 inches.

1. In the rafter tables on a steel square we find the length per foot run of a one-third pitch rafter gives us 14 5/12 inches. Find the length of the rafter for the rear of the house.

2. Find the length of the rafter for the front part of the house.

3. What numbers on the square should be used to lay out the top and bottom cuts for these two rafters?

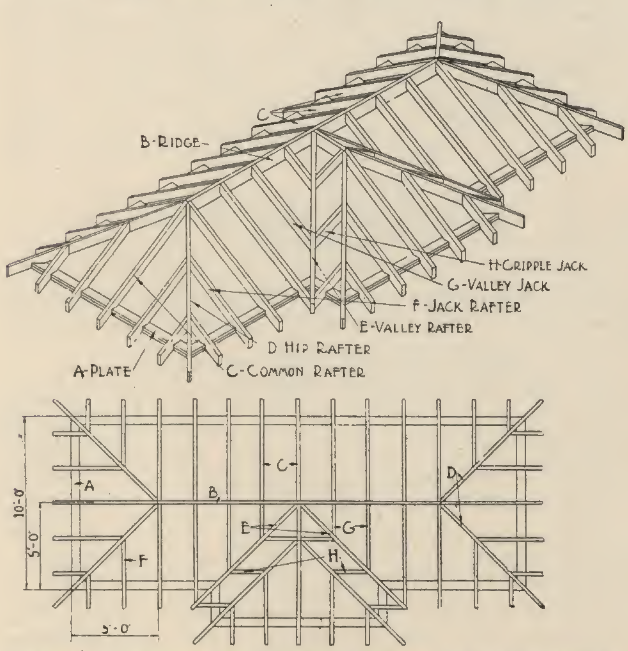


Fig. 16. Showing the Different Parts of a Hip Roof.

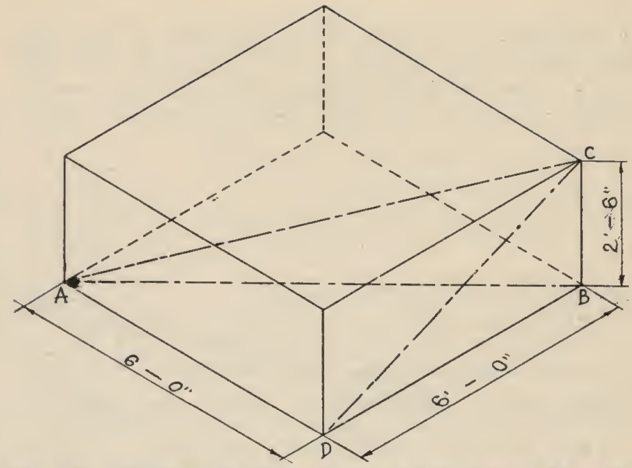


Fig. 17. Finding the Length of a Hip Rafter May Be Compared to Finding the Diagonal of a Box.

4. The dormer rafter has a 33-inch rise per foot run. What is the total rise in 10 feet?

5. The length per foot run for a rafter having a 3-inch rise per foot run is given on a rafter table as 12.57 inches. What is the length of the rafter for the dormer?

6. What numbers on the square may be used to obtain the top and bottom cuts of this rafter? Give two sets of numbers that may be used.

Answers

1. The rafter has a run of 11 feet. The length per foot run is 14 5/12 inches. The total length is 11×14 5/12=154 55/12=158 7/12 inches, or 13 feet, 9 inches.

2. The length of the rafter for the front part of this house is 16×14 5/12=224 80/12 inches = 230 8/12, or 19 feet 2 2/3 inches.

3. The rise per foot run is 8 inches; therefore, use 8 on the tongue and 12 on the blade to obtain the top and bottom cuts for the two main rafters.

4. The total rise for the dormer rafter is 10 + 3 = 30 inches, or 2 feet 6 inches.

5. The length per foot run of the dormer rafter is 12.37 inches and there are 10 feet in the run. The total length, therefore, is 10 × 12.37 = 123.7 inches, or 10 feet 3.7 inches (10 feet 3 11/16 inches).

6. We may use the numbers representing the total rise and the total run. (The total rise is 2½ feet and the run is 10 feet. Therefore, we may use 10 on the blade and 2½ on the tongue to get the top and bottom cuts for the dormer rafter).

As the rise per foot run is 3 inches we may also use 3 on the tongue and 12 on the blade to lay out the top and bottom cuts for this rafter.

The Hip Rafter

The hip rafter embodies more difficult problems than the common rafter, but if we will review the instructions on the common rafter, we will not have much trouble with the hip rafter.

In Figure 16 we show the several parts of a hip roof. The lower part of the illustration is a plan view and the upper part is an isometric or as might be called a sort of perspective. The plan view when drawn to scale will give the run of the different rafters but not the lengths.

Finding the length of a hip rafter may be compared to finding the diagonal of a box.

In Figure 17 we show a box with a width and length of 6 feet and a height of 2 feet 6 inches.

A school boy would find it easy to get the lengths of the different diagonals. He would first find the length of the diagonal of the bottom of the box from A to B and then

he would find the diagonal of the box from A to C. He might also find the diagonal of the side of the box from C to D. He would use "square root." However, we are sometimes afraid to use square root too much for fear of

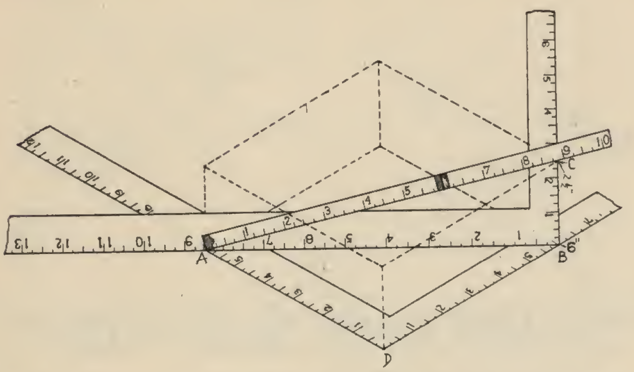


Fig. 18. Compare This Box Figure with the Illustration of a Hip Roof in Fig. 19.

being called down. We will start with a simpler method.

If we compare a part of a hip roof with this box will have the following comparisons:

A is the corner of the building.

B to C is the total rise of the roof.

D to B is the run of the common rafter.

D to C is the length of the common rafter.

A to B is the run of the hip rafter.

A to C is the length of the hip rafter.

Compare Figure 18 with Figure 19.

With the help of the steel square we may now find the length of the hip rafter without any calculations.

Lay the first square flat on the bottom of the box as shown. Each edge of the bottom is 6 feet 0 inches. If we measure across between the six on the tongue and the six on the blade, we find the length from A to B which is the run of the hip rafter. This is nearly 8 6/12 or 8½ inches. Therefore the run is 8 6/12 feet or 8 feet 6 inches.

Another square may be placed with the blade along the run of the hip, and the tongue along the rise. The run is 8½ feet and the rise is 2½ feet. We measure between the points 8½ on the blade and 2½ on the tongue and find the length of the diagonal that stands for the length of the hip rafter. This distance is 8 10/12 inches. Therefor the length of the hip rafter is 8 10/12 feet or 8 feet 10 inches. By this method of measuring across the square we may find the length of rafters to a fair degree of accuracy. However, care should be taken in measuring. Steel squares usually have one side graduated into twelfths of an inch. If we take inches for feet, twelfths of inches on the square represent inches on the rafter.

Another method that is more commonly used for finding the length of hip rafters is the length per foot run method. In this method we use the foot run of the common rafter as a basis.

The hypotenuse of a right triangle whose sides are each 12 inches is 16.97 inches long.

We see from the illustration (Fig. 17 and 19) that the run of hip rafter forms the hypotenuse of a triangle whose sides are the run of common rafter and the length of plate. (In the illustration this is the length of the plate from corner of building to first common rafter).

If we take only 1 foot of run and 1 foot length of plate, we have a right triangle whose sides are each 12 inches long and whose hypotenuse is 17 inches or, more accurately, 16.97 inches.

The long side, or hypotenuse in this case, is a portion of the run of hip rafter corresponding to 1 foot run of common rafter. Therefore, we can say that the "run of hip" is always 16.97 inches for every foot (12 inches) run of common rafter, if the roof is of even pitch.

The hip rafter always has the same rise as the common rafter, therefore the rise for each 17 inches of run of hip is the same as the rise per foot run of common. In this problem the rafters have a rise of 5 inches per foot "run of common rafter" or 5 inches for every 17 inches of "run of hip."

To get the length of hip rafter per foot run of common rafter take 17 inches on the blade of the square and 5 inches on the tongue. This is usually stated thus: run of hip on blade, rise of hip on tongue. The distance between these two points is 17 2/3 inches. This is the length of hip rafter per foot run of common rafter. This length can be figured more accurately thus: Length of hip rafter per foot run equals the square root of the sum of the squares of 16.97 and 5 = 17.69 inches.

In actual work we usually take this length per foot run from tables in handbooks or on the steel square.

The common rafter in this problem has a 6-foot run and therefore there are also six such lengths for the hip rafter, as can be seen in the illustration. The total length of hip rafter, therefore, is 6 × 17.69 inches = 106.14 inches = 8 feet 10⅛ inches.

In Fig. 20 we show a small framing detail at the point where the hip rafter meets the ridge. This is a view in plan and shows the upper ends of the rafters as seen from above.

The length of hip just found is to the center point 0. As the hip rafter does not extend to this point we must

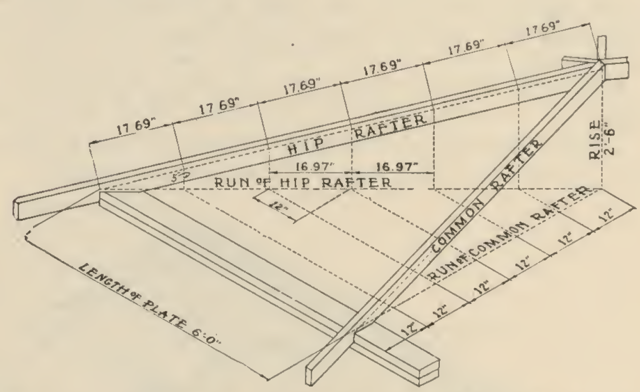


Fig. 19. Illustrating the "Length Per Foot Run" of a Hip Rafter.

deduct a small amount from the length. On a horizontal plane this is 17/32 inches and is deducted as shown in the lower part of the illustration.

The table below gives the length of hip per foot run.

Pitch of Roof	Length of Hip per foot run
1/6	1-5-6
1/4	1-6-0
1/3	1-6-10
5/12	1-7-9
1/2	1-8-10
5/8	1-10-8
3/4	2-0-9

This table is in the same form as found on steel squares. In the column headed "Length of Hip per foot run," the first figure represents feet, the second inches, and the third twelfths of inches. Thus 1-5-6 = one foot, five and six twelfths inches (1 foot 5 6/12 inches).

When figuring from a table like this it is best to use duo-decimals. Example: A roof is 16 feet wide and the pitch is 1/3. The length of the hip per foot run is given as 1-6-10. The run is 8 feet. The length is found thus:

```
  1-6-10
       8
  ------
     6-8
   4-0
   8-
  ------
12-6-8=12 feet 8/12 inches.
```

The operation is as follows: 8 × 10 = 80, which = 6 feet 8 inches and is put down 6-8.

8 × 6 = 48 which = 4 feet 0 inches and is put down 4-0.

8 × 1 = 8 and is put down as 8.

Adding up we have 12-6-8 = 12 feet 6 inches and 8/12; or 12 feet 6 8/12 inches as the length of hip rafter.

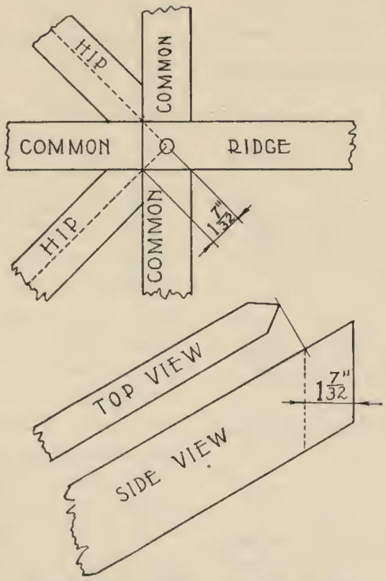


Fig. 20. How to Deduct for Ridgeboard from Length of Hip Rafter.

Problems

1. From the table find the length of hip per foot run for a 1/4 pitch; for a 5/12 pitch; for a 3/4 pitch.
2. If the roof in Figure 16 is 5/8 pitch what is the length of the hip rafter?
3. A roof has a 10-inch rise per foot run. The span is 28 feet. What is the length of the hip rafter?

Answers

1. The length of hip per foot run for a 1/4 pitch is 1 foot 6 inches; for a 5/12 pitch is 1 foot 7 9/12 inches; for a 3/4 pitch is 2 feet 0 9/12 inches.
2. For a 5/8 pitch roof the length of hip per foot run is 1 foot 10 8/12 inches. The run is 5 feet 0 inches. The length is 5 × 1 foot 10 8/12 inches. 5 × (1-10-8) = 5-50-40 = 9 feet 5 4/12 inches.
3. A roof has a rise per foot run of 10 inches. If the rise is 10 inches per foot run then it is 10 inches for every 2 feet in span, or 10/24 pitch (10/24 = 5/12). The length of hip for a 5/12 pitch is 1-7-9 = 1 foot 7 9/12 inches. The run of roof = 1/2 of 28 = 14 feet. The length of hip is 14 × (1-7-9). This may be worked thus: 14 × (1-7-9) = 14-98-126 = 23-0-6 = 23 feet 0 6/12 inches.

Cutting the Hip Rafter

In order to get a clear understanding of the difference between the common rafter and the hip rafter we will figure the lengths and cuts for the common rafter and also for the hip rafter of the roof shown in Fig. 21.

Laying Out the Common Rafter

This roof is 16 feet wide and the rise is 6 feet. The pitch is 6/16 = ⅜. To find the rise per foot run we proceed as follows: The roof rises 6 feet or 72 inches in 8 feet of run. In one foot of run the roof rises 72 ÷ 8 = 9 inches. This may be also found by multiplying the pitch by 24. ⅜ × 24 = 9 inches.

In some rafter tables we may find the length per foot run of rafters for any pitch. For a ⅜ pitch this is given as 15 inches. The tables on the steel square also give the length per foot run of rafters, but they only give a few pitches and this one is not given.

The common rafter has an 8-foot run. The length is the length per foot run times the run in feet. Therefore, the length of the common rafter is 15 in. × 8 = 120 inches = 10 ft. 0 in. As the rise per foot run is 9 inches, we may use the 9 on the tongue and 12 on the blade to lay out the top and seat cuts for this rafter. Fig. 22 shows how the length and the cuts are laid out on the rafter.

Laying Out the Hip Rafter

As explained in the preceding section we may also find the length of the hip rafter by the length per foot run method. The run of the hip is 16.97 inches, usually stated 17 inches, for every foot run of the common rafter. This is also shown in Fig. 21 by the two steel squares. On one 12 inches are taken on the blade and on the other 17 inches.

The length of hip for each foot run of common rafter is also given in tables, and these are handy and a time saver in figuring hip rafter lengths. The length of hip rafter per foot run of common rafter is given as 19.21 inches. To find the total length of the hip rafter we multiply the length per foot run by the total run of the common rafter. Therefore, the length of the hip rafter is 19.21 × 8 = 153.68 inches, or 12 feet 9 11/16 inches.

The square at the lower end of the hip rafter in Fig. 21 shows how the seat cut is obtained. The number taken on the tongue is the same as is used for obtaining the cuts for the common rafter. That is, take the rise per foot run, which is 9 inches in this case, on the tongue. On the blade we take 17 inches instead of 12 inches as for the common rafter, because the run of the hip rafter is 17 inches for every 12-inch run of the common rafter. The numbers 17 and 12 will, therefore, give the bottom or seat cut for the hip. These same numbers also give the top cut. Fig. 22 shows how the length and also the cuts for the hip rafter are laid out.

In the upper part of Fig. 22 we have shown how the cuts of the hip rafter may be laid out by using the total run of the hip on the blade and the total rise on the tongue. The total run of the hip rafter is 11.31 feet or 11 5/16 feet,

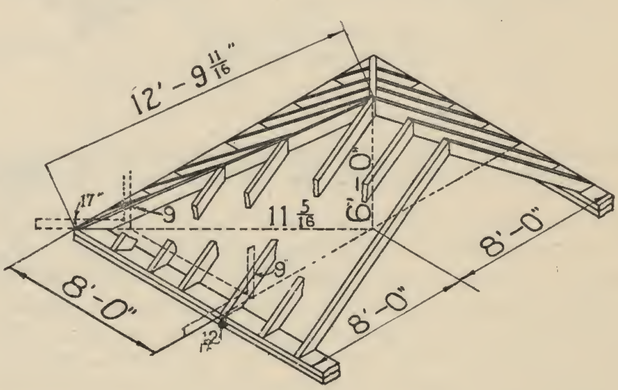


Fig. 21. Illustrating the Hip Roof Used in a Problem in This Lesson.

therefore we take 11 5/16 inches on the blade. The total rise is 6 feet, therefore we take 6 inches on the tongue. These numbers taken on the square of course lay out the same angle as the ones below it in the same figure.

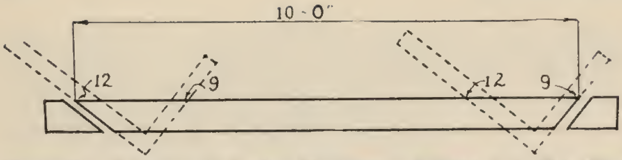


Fig. 22. Laying Out the Common Rafter for the Roof Shown in Figure 21.

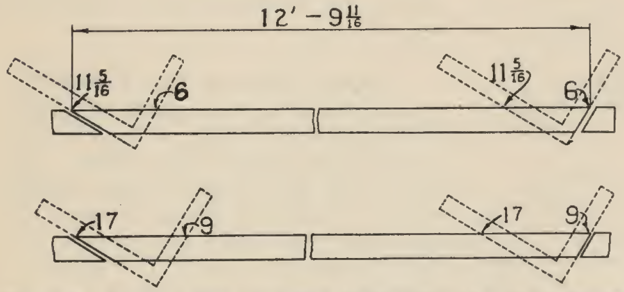


Fig. 22. Laying Out the Hip Rafter for the Roof Shown in Figure 21

Side Cut of Hip

The detail in the circle of Fig. 23 shows the meeting point of the hip rafter and the common rafter. This detail shows us that the hip rafter requires a side cut at the upper end.

In order to learn how to lay out this side cut it is best to see first what this side cut would be if the roof was flat as shown in Fig. 23. Then this side cut would be a 45-degree cut because the hip rafter runs at an angle of 45 degrees with the common rafter. If we lay a square along the hip rafter so that the blade coincides with the hip then the tongue takes the position as shown in Fig. 23. A line is drawn along the common rafter and continued until it meets the tongue of the square. Up to this point the distance along the tongue of the square is the same as the distance along the run of the hip rafter.

If the roof takes on a rise or pitch as shown in Fig. 24,

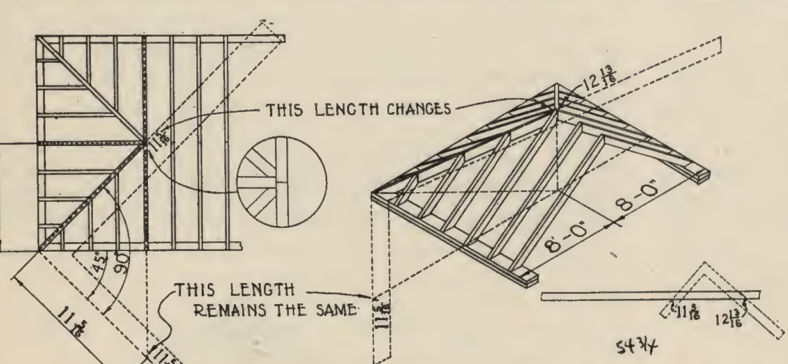


Fig. 23 (Left). Fig. 24 (Right). Illustrating the Principles on Which the Rule for Obtaining the Side Cut of the Hip Rafter is Based.

then the distance along the blade changes with the length of the hip rafter. The distance along the tongue of the square, however, remains the same. The square in this position describes the side cut of the hip rafter, as is required to fit against the common rafter. The side cut against the hip, of course, is the same on both sides. From this application of the square we may assume that if we take the length of the hip on the blade and the distance shown on the tongue, we will have the angle for the side cut of the hip. As stated before the distance on the tongue is the same as the run of the hip.

For laying out the side cut, therefore, we take the length of the hip on the blade and the run of the hip on the tongue and apply this to the back of the rafter as shown in Fig. 24.

In the case of the rafter in our problem, the length of the hip is 12 13/16 feet and the run is 11 5/16 feet, therefore we take 12 13/16 inches on the blade and 11 5/16 inches on the tongue.

In place of the total length and the total run we may also take the length per foot run (19.21 inches) and the run corresponding to one foot of run of common rafter (17). Thus, 19¼ and 17 would give the same angle for the side cut. The side cut is laid out on the back of the rafter.

Backing the Hip

In Fig. 25 we show the lower end of the hip rafter as it fits on the plate. It will be noticed that the edges extend beyond the plate. They are, therefore, also higher than the other rafters. The corners or edges of the hip must be cut off or the hip must be set lower so that the edges coincide with the dotted line as shown at B. Cutting off the corners or edges of the hip is called Backing the Hip.

There are various way by which the amount of backing is found. Sometimes the edges are merely cut off with the hatchet after the hip is placed. If it is desired to do the backing before the hip is placed then the line of backing may be found as illustrated in Fig. 25.

First make the horizontal cut for the seat. Next draw two lines as shown at C. These lines make an angle of 90 degrees with each other; and indicate the lines of the corner of the building or of the plate on which the rafter will sit. The point at which these lines meet the side of the rafter is the point through which the line of backing must be drawn. The line of backing, as shown by the dotted line, indicates how far the corners of the hip must be planed off.

Problems

1. What is the run of the hip rafter for one foot of run of common rafter?

2. What numbers on the square will give the plumb and also the seat cut of a hip rafter for a roof with a 6-inch rise per foot run?

3. The length of hip per foot run of common rafter for a ¼ pitch roof is given on tables as 18 inches. What is the length of hip rafter for a building 30 feet wide?

4. What numbers on the square will be used to lay out the side cut of the hip rafter of the previous problem?

Answers

1. The run of the hip rafter corresponding to one foot run of common rafter is 16.97 inches, usually stated as 17 inches.

2. The numbers 17 and 6 taken on the square will give the plumb and seat cut of a hip rafter for a roof with a 6-inch rise per foot run.

3. On a building 30 feet wide the run of common rafter will be 15 feet. If the length of hip per foot run of common rafter is 18 inches, then the total length is 18 × 15 = 270 inches = 22 feet 6 inches.

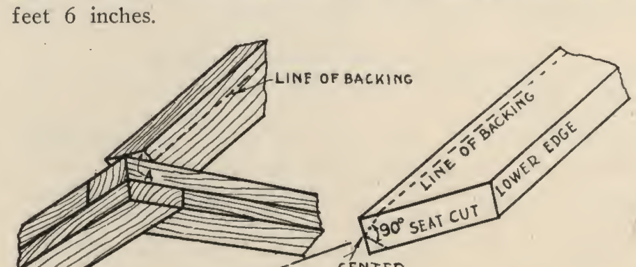


Fig 25 (Left). Close View of a Corner of a Roof Showing the Backing Line of the Hip Rafter. Fig. 26 (Right). An Easy Way to Determine the Amount of Backing for the Hip Rafter.

4. For laying out the side cut of this hip rafter we may use the length of hip per foot run of common rafter (18 inches) on the blade and the run of hip per foot run of common rafter (17 inches) on the tongue. We may also use the numbers representing the total length and the total run.

Dormer Framing

The dormer roof illustrated in Fig. 28 presents some of the difficult roof framing problems connected with dormer framing.

When framing this dormer we must first set the two main rafters lettered A. The main roof has an 8 inch rise per foot run—1/3 pitch. The length of these main rafters can be found by multiplying the length of the rafter for one foot run (as given in tables) by the number of feet in the run. The length per foot run is 14.42 inches for a 1/3 pitch. The run of the rafter is 14 feet.

The total length is 14 × 14.42 = 201.88 inches = 16 feet 9 7/8 inches.

Another rafter "B" is nailed to the rafter A for stiffening the roof.

After these rafters have been framed the dormer walls are framed. If we wish to use the square for marking the cut at the lower end of the studs for the side of the dormer we may use the same numbers as for the plumb and seat cut of the common rafter, 8 and 12 in this case, marking on the arm on which the 8 is taken.

The front of this dormer is 4 feet 0 inch above the main roof at the face of the dormer. This makes the length of the plate of the dormer 6 feet 0 inch to the point D. This

1 foot of run of the common rafter. This total length would be six times this = 6 × 18.76 = 112.56 = 9 feet 4 9/16 inches. From this we must deduct one-half the thickness of the ridge on one side and one-half the thickness of the rafter on the other side. This valley rafter as it meets the ridge and common rafter has two side cuts and a plumb cut at the top.

The plumb cut at the top and the seat cut are laid out by using the rise per foot run on the tongue and 17 inches on the blade. (The run of hip is 17 inches per foot run of common rafter.)

The side cut is the same as the side cut of a hip rafter taking the number representing the length per foot run on the blade of the square and 17 inches on the tongue; laying this on the upper edge of the rafter and marking along the tongue. This side cut was illustrated in our last lesson.

The valley rafter G known as the short valley is figured by the run of the dormer rafter. The dormer is 8 feet wide, therefore, the run of the common rafter is 4 feet. The length of valley per foot run is the same as for the long valley = 18.76 inches.

The length of the short valley is 18.76 inches × 4 = 75.04 inches = 6 feet 3 1/16 inches.

The seat cut is the same as for the other valley. At the top is a plumb cut using the numbers 17 and 8. The cut across the top is a square cut regardless of the pitch of the roof.

The next rafters to put up are the common rafters H for the dormer. This dormer has the same pitch as the main roof. The length per foot run for a 1/3 pitch roof, for the common rafter is 14.42 inches. The run is 4 feet 0 inch and the length is 4 × 14.42 = 57.68 = 4 feet 9 11/16 inches.

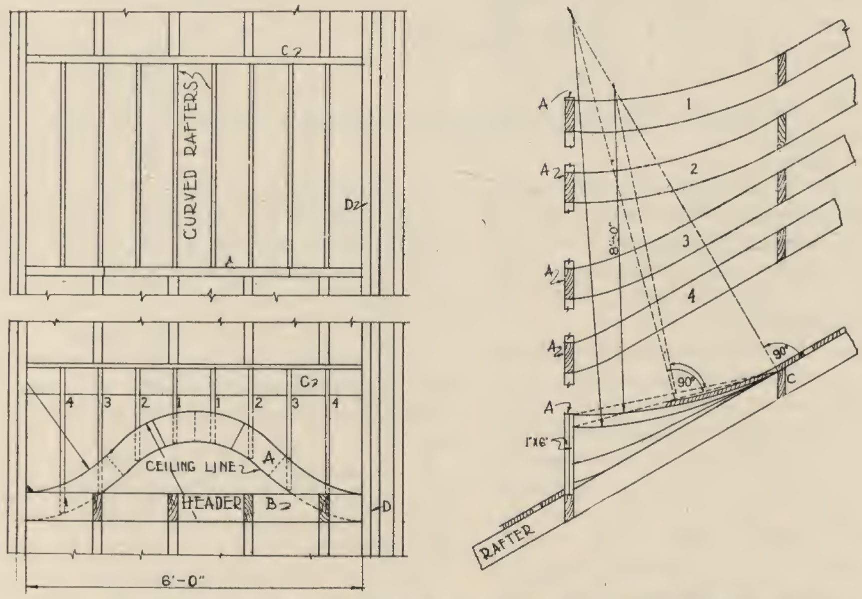


Fig. 27. The Proper Method of Framing an Eyebrow Window.

is found as follows: The rise of the roof is 8 inches per foot. The total height of the dormer or the rise of the main roof up to the level of the dormer is 4 feet 0 inch. To make the rise the run must be 48 ÷ 8 = 6 feet because it rises 8 inches per foot run.

The next step it to put in the valley rafter E. This rafter covers a 6-foot run in either direction.

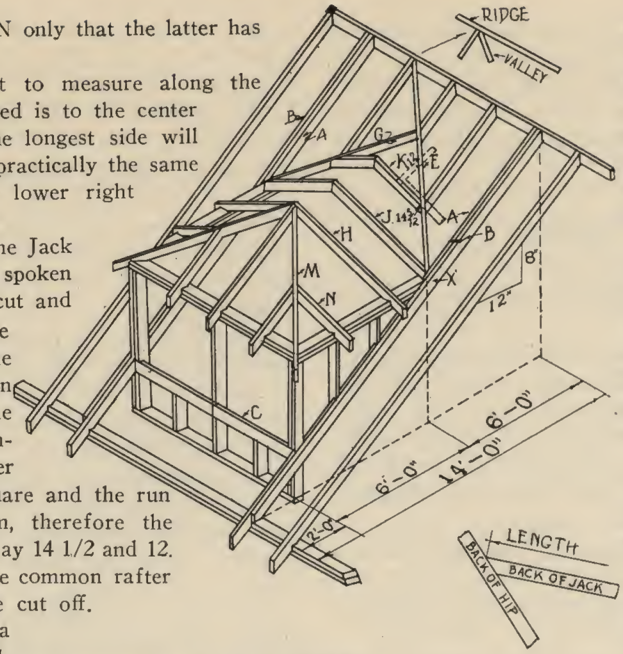
To find its length we proceed as for hip rafters. The length of hip per foot run of common rafter (given on tables) is 18.76 inches. This is the length corresponding to

The numbers to use for the cuts are 12 and 8 as the rise per foot is 8 inches.

The rafters K and N are Jack rafters. These are similar in many respects to the common rafters only that they do not extend the full length, as the common rafters do, as the rafters are spaced 2 feet 0 inch on centers (in this case), therefore the first Jack rafter is 2 feet 0 inch from the corners and the run for this rafter is 2 feet 0 inch. The length would be two times the length per foot run = 2 × 14.42 = 28.84 = 2 feet 4 13/16 inches. The rafter K

is the same length as the rafter N only that the latter has a tail end.

In measuring these it is best to measure along the longest side as the length obtained is to the center of the hip. Measuring along the longest side will take care of this as it makes it practically the same as shown by the detail at the lower right hand corner.



The cut at the upper end of the Jack rafter has a double bevel. It is spoken of as both a plumb or vertical cut and also a side cut. To mark for the vertical cut we use the same numbers as for the common rafter, 12 and 8. For the side cut the rule is to use the numbers representing the length per foot run on one arm of the square and the run of 12 inches on the other arm, therefore the side cut would be 5/12 or 14.42, say 14 1/2 and 12.

The rafter J is the same as the common rafter H except that the toe has to be cut off.

The rafter K is known as a valley jack. It is 2 feet 0 inch from the rafter J. The run of this rafter is 2 feet 0 inch less than the run of the common rafter. The length is 2 × 14.42 = 24.84 inches = 2 feet 4 13/16 inches. The top cut of this rafter is the same as the top cut of the common rafter but the cut at the lower end is different. Here it frames against the valley rafter. To mark for this cut we use the numbers 12 and 8 on the square and mark on the side of the rafter for a plumb cut as shown in Fig. 27. As this end also has a side cut we must mark for this on the upper edge of the rafter. A square placed with the blade along the rafter and the tongue along the ridge would give the numbers to use for this side cut if the square was large enough. However, we may place a square along the rafters as shown in the illustration, so that the tongue meets the edge of the valley at the 12 inch point.

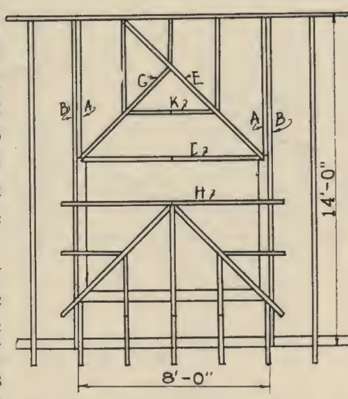
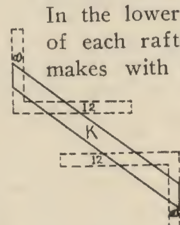


Fig. 28. Showing the Method of Framing a Dormer Roof.



The length on the square then will be the same as the length per foot run = 14.42 or 14 5/12. From this we obtain the rule. To lay out the side cut of a jack rafter use 12 on one arm of the square and the length per foot run on the other arm. In this case we use 14 5/12 or say 14 1/2 and 12 to lay out the angle for the side cut to fit against the valley.

The hip rafter M has the same length per foot run as the valley 18.76 inches. The length is 4 × 18.76 inches = 75.04 inches = 6 feet 3 1/16 inches. The top and plumb cuts for this rafter are laid out by taking the numbers 17 and 8 on the square. This part is explained more in detail in the last lesson. The side cut for the hip is obtained by taking the length per foot run, 18¾, on the blade and the run of 17 inches on the tongue.

Framing an Eyebrow Window

The following framing of an eyebrow window can be used where it is desired to make the inside ceiling of the same shape as the outside, or the roof. See figure 27.

Cut a rectangular piece in your roof and place headers B and C as though you were framing for a stairway. Headers B and C are made of 2 by 6s, if the rafters are 2 by 4s. For wide windows, these headers should be doubled. The next thing is to cut the curved rafter A which gives the shape of the front of the eyebrow window. The architect's details will usually give the radii to use for laying out the eyebrow window. These same radii should be used for cutting the piece A.

In this case, we have assumed the width 6 feet 0 inch and the radius for the various curves as 2 feet 0 inch. Piece A can be cut out of short pieces of inch boards and spiked together. This piece should be nailed vertically over header B.

The next step is to lay out rafters, 1, 2, 3, and 4. These are made of inch boards and should be placed close together. In this case, they are placed on 8-inch centers. It is best to lay these out on paper before starting to lay them out on the job.

The radius of the upper rafter, in this case, has been taken as 8 feet. This, of course, would depend upon the shape that the eyebrow is shown in the architect's drawing. In the lower right-hand corner, the upper edge of each rafter is shown and the curve that it makes with the main rafter. In the upper right-hand corner, each rafter is shown separate, as it would be cut and spiked together.

One end of each of these 1-inch rafters is spiked to piece A and the other end, to header C. The headers B and C when made of 2 by 6 boards, can be chipped off at the bottom, so that the ceiling line is unbroken. For sheating, several thicknesses of thin boards can be sprung to shape on the ground before putting them on the roof. For the ceiling, metal lath can be used. The sheathing boards are run in the same direction as they run on the main part of the roof.

Problems

After studying the framing of the dormer of figure 27, it will be well to assume a different pitch for both the main roof and the dormer and to figure the lengths of the different rafters.

1. Assume that both the main roof and also the dormer have a 10 inch rise per foot run or 5/12 pitch. Find the height of the front of the dormer.

Use this table.

Pitch	Length per foot run for common rafter	Length per foot run for hip
¼	13.42 inches	18.00 inches
⅓	14.42 inches	18.76 inches
⅜	15.00 inches	19.21 inches
5/12	15.62 inches	19.69 inches
½	16.97 inches	20.78 inches

2. Find the length of the hip rafter M.
3. Find the length of the valley G.
4. Find the length of the valley E.
5. Find the length of the Jack N.
6. Give the numbers for the side cut of the Jack rafters.
7. Give the numbers for the side cut of the valley G.
8. Give the numbers for the side cut of the valley E.

Answers

1. The height of the front of the dormer is 10 × 6 = 60 inches = 5 feet 0 inch.
2. The length of the hip M is 4×19.69 inches = 78.76 = 6 feet 6¾ inches.
3. The length of the valley G is the same as the hip M. It is 6 feet 6¾ inches.
4. The length of the valley E is 6 × 19.69 = 118.14 inches = 9 feet 10⅛ inches.
5. The length of the jack N is 2 × 15.62 = 31.24 inches = 2 feet 7¼ inches.
6. The numbers for the side cut of the Jack rafters are 15½ and 12 marking along the arm on which the 12 is taken.
7. The valley G has no side cut at the upper end.
8. The numbers for the side cut of the valley E are 19⅝ and 17.

Framing an Octagon Roof

In the preceding chapter we compared the square, hexagon and octagon roof in plan. We will now take a more definite problem and show how each part of the octagon roof is figured and cut. The roof illustrated by plan and isometric view in Figs. 29 and 30 will be used as a problem. This roof is 12 feet 0 inch wide and 4 feet 0 inch high. This gives the common rafter a run of 6 feet and a rise of 4 feet 0 inch in 6 feet 0 inch or 8 feet per foot. The pitch is the rise over the span = 4/12 1/3. Our first problem is to find the length and cut for the plate.

In Fig. 29 at A we show a small triangle, one side of which is equal to 1 foot or 12 inches of run of the common rafter. We note that the side that is parallel to the plate is 4.97 inches long and that the length corresponding to the run of the hip is 12.98 inches long. As we learned in our last discussion, the line perpendicular to the run of the common rafter is called the tangent. For every foot of run we have 4.97 inches, length of tangent. The total run in this case is 6 feet. Therefore the tangent is 6 × 4.97 = 29.82 inches. The length of the plate of each side is two times this = 2 × 29.82 inches = 59.64 inches = 4 feet 11⅝ inches.

Some of our readers may have difficulty in changing decimal parts of an inch to ordinary fractions. This is quite simple. To show this we will change the above .64 of an inch into a fraction that can be measured with an ordinary rule. Changing .64 to sixteenths we multiply .64 by 16 and get 10.24. Therefore, .64 inch is equal to 10.24/16 inch, say 10/16 or 5/8 inch.

The joint at the corner of the plate is parallel to the run of the hip rafter. Therefore the triangle which is described

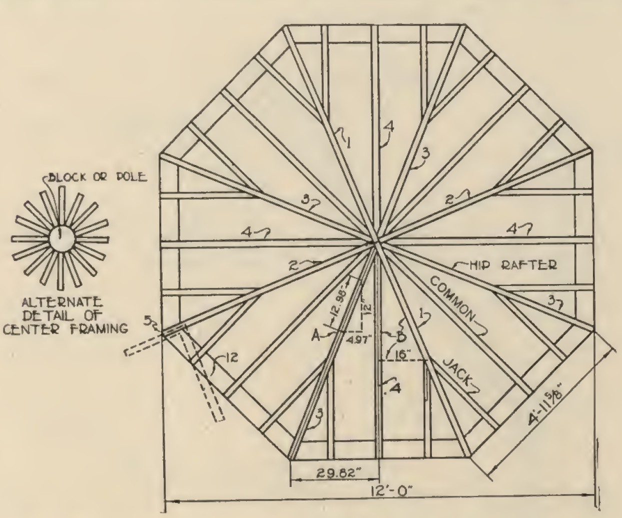


Fig. 29. Plan of Octagon Roof Solved in this Lesson.

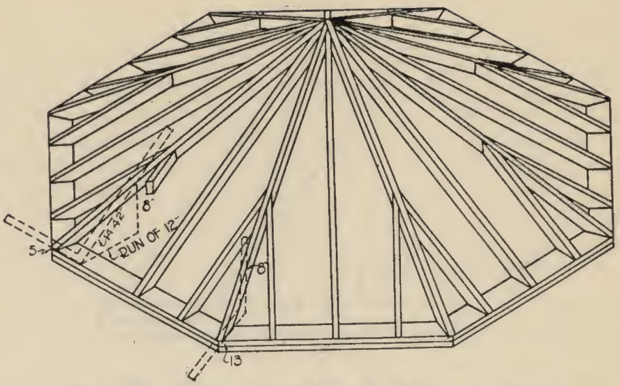


Fig. 30. Isometric View of Octagon Roof.

by the run of the common rafter, the plate and the run of the hip rafter, also describes the cut for the plate. This would be laid out by using 12 on the blade and 4.97 or 5 on the tongue of the square. See Fig. 29.

The Hip Rafter

The next number in order for framing is hip rafter No. 1. The hip rafter has a run of 12.98 inches for every foot run of the common rafter. The length of hip per foot of run of common rafter is generally taken from a table similar to the one given here. Note carefully that the length of hip is given per foot of run of common rafter and not per foot of run of hip rafter. For a one-third pitch the length of hip is given as 15.26 inches per foot of run of common rafter. The total length of the hip rafter is 6 × 15.26 inches = 91.56 inches = 7 feet 7 9/16 inches.

In laying out the cut for the hip rafter we use the same principle as we have been using on a square-cornered roof. The run of the hip and the rise will describe the cut for the top and bottom. We may take the total run and the total rise in feet and use these numbers on the square or we may use the run of hip per foot run of common rafter, which is 12.98 or 13 inches and the rise per foot run which is 8 inches. Thus 13 and 8 taken on the square will lay out the seat cut and also the top or plumb cut for the hip rafter. There is no side cut for the two hips numbered "1."

The two hips numbered "2" will be the same in length with the exception of one-half the thickness of the first hip. This can be deducted as shown by Fig. 31. One-half the thickness of a rafter 1 5/8 inches thick is 13/16 inch. This is measured horizontally as shown. The hips numbered "3" on the plan are also similar in length, but a deduction must also be made as shown in Fig. 32. First we measure the length of deduction on a horizontal plan. This distance, 1 7/32 inches, is then measured on a horizontal line on the side of the rafter shown in Fig. 32.

The Common Rafter

Rafter No. "4" on the plan may be considered as a common rafter and can be figured the same as on a square-cornered building. The pitch is one-third and the rise per foot of run is 8 inches. The length per foot of run as given on tables is 14.42 inches. The run is 6 feet. The length, therefore, is 6 × 14.42 inches = 86.52 inches = 7 feet 2 1/2 inches. This is the length up to the center point of the roof. A deduction must be made at the center the same as for the hip rafters. The distance to be deducted in plan is 2 1/8 inches, see Fig. 32. This is again measured off on the side of the rafter the same as the 1 7/32-inch on the hip No. "3."

There is also a side cut to be made for the common rafter. This is the same as the side cut for jack rafter and is illustrated in Fig. 30.

A square is placed so that the blade is parallel or in the

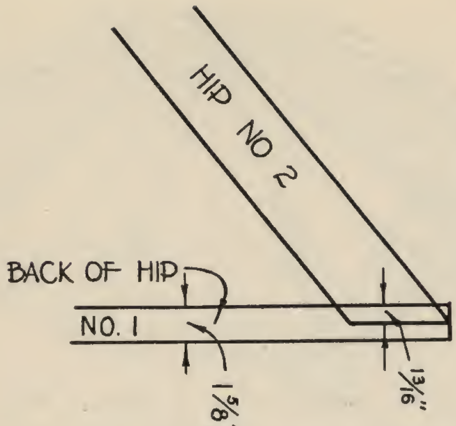


Fig. 31. Deduction to Be Made at Upper End of Hip Rafter No. 2.

same planes as the common or jack rafter and the tongue lies along the edge of the plate. The length of jack or common rafter is 14.42 inches per foot of run and the plate length is 4.97 inches or 5 inches. The square in this position gives us the numbers to be used for laying out the side cut, 5 and 14 1/2. The side cut is marked on the back of the rafter along the arm of the square on which the 14 1/2 is taken.

The Jack Rafter

The length of the jack rafter is found in a similar way to the length of the common rafter. First we must find the run of the jack, we will see how much shorter the run of the jack is than the run of the common rafter. The jack is set 16 inches to the side of the common rafter. We have found that for every 12 inches of run there is a tangent length of 4.97 inches or 5 inches. If the jack rafter were set 5 inches to the side of the common rafter then the run would be 12 inches less. Therefore, for every 5 inches that the jack is set to one side its run is 12 inches less. It is set to the side 16 ÷ 5 = 3 1/5 × 5 inches and, therefore, the run is 3 1/5 × 12 = 3 1/5 = 3.2 feet less than the run of the common rafter. The run of the jack is 6 feet less 3.2 feet = 2.8 feet. The length is 2.8 × 14.42 inches = 40.376 inches = 3 feet 4⅜ inches.

Seat and plumb cuts are obtained the same way as for the common rafter, using 12 and 8 on the square.

The side cut is the same as explained under the common rafter, using the numbers 5 and 14½ on the square and marking along the arm on which the 14½ is taken.

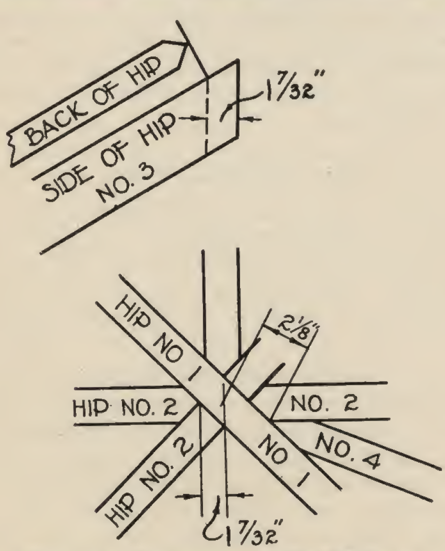


Fig. 32. Deduction to Be Made at Upper End of Hip Rafter No. 3.

In Fig. 26, at the left-hand side, we illustrate how the framing at the center may be simplified. A big block or pole from 6 to 8 inches in diameter is used at the peak of the roof to which all the rafters frame. By using this block the side cuts on the rafters are avoided. This simplifies the framing.

Table for Octagon Rafters

Pitch—	Riser Per Foot Run	Length of Common Rafter Per Foot Run	Length of Hip Rafter Per Foot Run
One-sixth	4 inches	12.65 inches	13.59 inches
One-fourth	6 inches	13.42 inches	14.30 inches
One-third	8 inches	14.42 inches	15.26 inches
Three-eighths	9 inches	15.00 inches	15 80 inches
Five-twelfths	10 inches	15.62 inches	16.40 inches
Eleven-twenty-fourths	11 inches	16.28 inches	17.03 inches
One half	12 inches	16.97 inches	17.69 inches
Two-thirds	16 inches	20.00 inches	20.61 inches
Three-fourths	18 inches	21.63 inches	22.20 inches

Problems

1. An octagon roof has a span 20 feet 0 inch. What is the length of the plate for one side?
2. What numbers on the square will give the cut for the plate at the corner?
3. If the above roof has a one-half pitch, what would be the length of hip rafter No. 1?
4. What would be the length of the common rafter, not deducting any for the center framing?
5. What numbers on the square would lay out the plumb and seat cut for the common rafters?
6. What numbers would lay out the side cut for the common rafter?
7. What numbers would lay out the plumb and seat cut for the hip rafter?

Answers

1. The length of the plate on one side is 10 × 4.97 inches × 2 = 99.40 inches = 8 feet 3⅜ inches.
2. The numbers 5 and 12 taken on the square will give the cut for the plate.
3. The length of hip per foot run of common rafter is 17.69 inches for a one-half pitch roof. The run is 10 feet 0 inch. The total length of the hip is 10 × 17.69 = 176.9 = 14 feet 8⅞ inches.
4. The length per foot run of common rafter is 16.97 inches; the run is 10 feet 0 inch and the length is 10 × 16.97 inches = 169.7 inches = 14 feet 1 11/16 inches.
5. The numbers 12 and 12 will lay out the plumb and seat cuts for the common rafter.

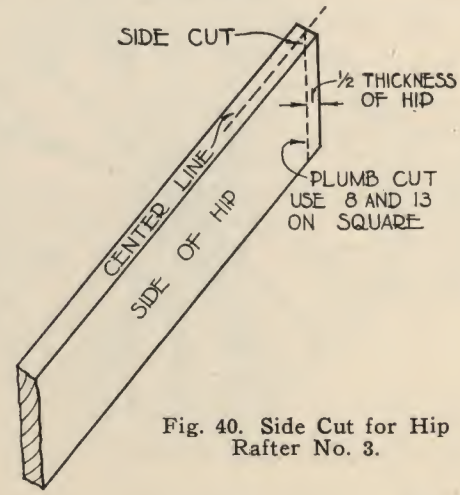


Fig. 40. Side Cut for Hip Rafter No. 3.

6. The numbers 12 and 17 will lay out the side cut for the upper end of the common rafter.

7. The numbers 13 and 12 taken on the square will lay out the plumb and seat cut for the hip rafters.

Study of the Square, Hexagon and Octagon Roof by Comparison

A comparison of the square, the hexagon and the octagon roof will illustrate or clear up many of the seemingly perplexing problems connected with roofs other than square cornered. There are many things that these roofs have in common and many things that are different.

Kinds of Rafters

The framing parts of these roofs are practically the same, being composed of common rafters, hip rafters and jack rafters. The common rafter is the same in all respects in each of these roofs that is for a roof of given span and pitch the run, length and angle of cut of the common rafter will be the same. Figs. 34, 35 and 36 illustrate by single lines the outline of each of the three roofs in plan.

Angles in the Three Roofs

The hips of any roof divide it into different parts similar to dividing a circle or a piece of pie.

On a square roof the hip rafters divide the roof into four parts, each part being one-fourth of a circle, or ¼ of 360 = 90 degrees. The hip rafter and the common rafter again make an angle of 45 degrees.

On the hexagon roof the six-hip rafters divide the roof into six parts and therefore the angle between two hips on a hexagon is 1/6 of 360 = 60 degrees. The hip rafter and the common rafter again make an angle one-half as great or ½ of 60 = 30 degrees.

On an octagon roof the hip rafters divide the roof into eight parts and two adjacent hips make an angle of ⅛ of 360 = 45 degrees. The hip and the common rafters form an angle of ½ of 45 = 22½ degrees.

The Tangent

In geometry we learn that a line that is at right angles to another line is tangent to that line, thus the plate of a roof is tangent to the common rafter. Therefore we call the distance from the foot of the first common rafter to the corner of the plate "the tangent," as is shown in the three illustrations, 34, 35 and 36, at the bottom of this page.

On a square-cornered building the tangent is the same as the run of the common rafter, therefore we have so many rules in roof framing in which the run of the rafter gives a number to be used on the square to obtain the side cut of a rafter. For example, we have the rule stating that to obtain the side cut of the jack rafter we must take the run of the common rafter on one arm of the square and the length of the common rafter on the other arm. Fig. 37 shows that it is really the tangent and the length of the common rafter that give the side cut for the jack rafter.

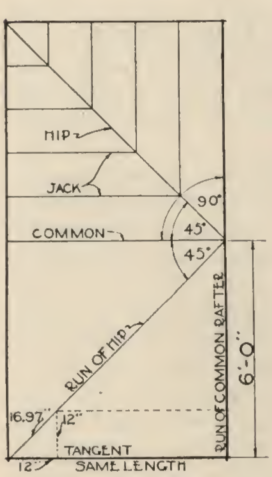
As stated, the tangent is the same as the run of the common rafter on a square-cornered roof, but on a six-sided or hexagon roof this is not the case. The hip rafter on a hexagon roof makes an angle of 30 degrees and the tangent for this angle is .57735 parts of the run (taken from trigonometry). Generally the length of the tangent (length of plate) per foot of run is given; thus for a one-foot run, or 12 inches, the tangent length is .57735 of 12 = 6.93 inches. This is shown in Fig. 34.

On the octagon roof the hip makes an angle of 22½ degrees with the common rafters. The tangent for this angle is given as .41421 parts of the run. For a one-foot run, or 12 inches, the tangent is .41421 × 12 = 4.97 inches.

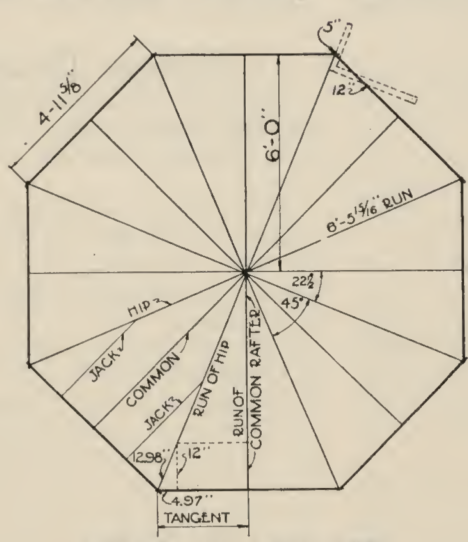
Length of Plate

The tangent value just found gives us a chance to find the length of plate for any size roof given. We note that one length is two times the tangent. The roof in the illustration has a run of 6 feet and we have just found that on a hexagon the tangent is 6.93 inches for every foot of run, therefore the length of tangent is 6.93 × 6 = 41.58 inches and the plate on each side is twice as long or 41.58 × 2 = 83.16 inches = 6 feet 11 3/16 inches. As the span is twice as long as the run it is easiest to multiply the tangent length per foot run by the span to get the length of the plate for one side. The span in this case is 12 feet and the tangent length per foot run is 6.93. The length of plate is 6.93 × 12 = 83.16 inches = 6 feet 11 3/16 inches.

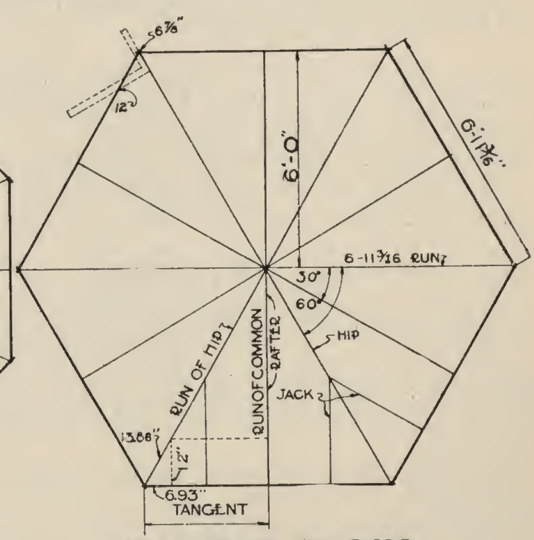
The same method can be used to find the plate length of the octagon roof. The tangent length per foot run is 4.97 inches and the span is 12 feet, therefore the length of the plate for each side is 4.97 × 12 = 59.64 inches = 4 feet 11⅝ inches.



SQUARE CORNERED ROOF
Fig. 34



OCTAGON OR EIGHT SIDED ROOF
Fig. 35



HEXAGON OR SIX SIDED ROOF
Fig. 36

These Three Sketches Afford a Comparison of the Square-Cornered Roof with the Octagon and Hexagon Roofs, the Framing of All of Which Is Practically the Same.

If we take the number giving the tangent length on the tongue of the square and 12 inches on the blade we obtain the angle for the cut of the plate at the corner. Thus, for the hexagon the number 6.93 or 6⅞ inches and 12 inches will give the cut of the plate. On the octagon roof the numbers 4.97 or 5 inches and 12 inches give the cut for the plate.

Run of Hip Rafter

We have previously found that on a square roof the run of the hip rafter per foot run of common rafter is 16.97 inches. We may also find the run of the hexagon and also of the octagon hip rafter after we have found the tangent length per foot of run.

The run of the common rafter and the tangent form a right angle of which the run of the hip rafter is the hypotenuse. Using the principle of the right triangle we find the run of hip per roof run of common by squaring the lengths of the two sides of the triangle, adding them together and extracting the square root. Thus the run of hip per foot run of common is equal to the square root of ($\text{tangent}^2 + \text{run of common}^2$). For the hexagon this is as follows:

Run of hip per foot run of common $\sqrt{6.93^2 + 12^2} = 13.86$ inches.

After we have the run of hip per foot run of common we can easily find the total run by multiplying by 6, as the run is 6 feet. Run of hip $= 6 \times 13.86 = 83.16$ inches $=$ 6 feet 11 3/16 inches. The run for the octagon hip per foot run of common rafter is found in the same way.

Run of hip $= \sqrt{4.97^2 + 12^2} = 12.99$ inches.

The total run of the octagon hip for the roof shown is $6 \times 12.99 = 77.94$ inches $=$ 6 feet 5 15/16 inches.

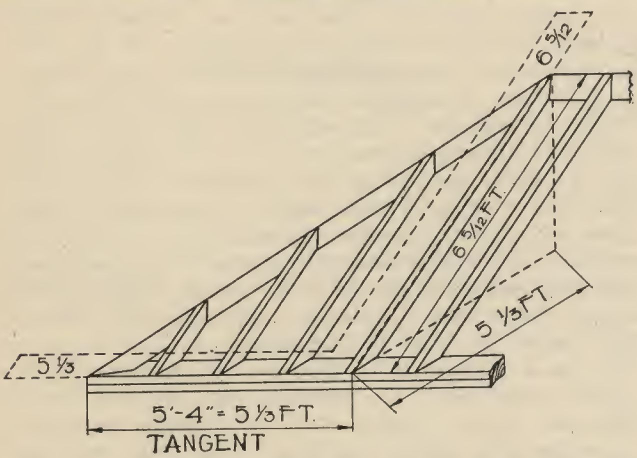


Fig. 37. This Shows How the Length of the Common Rafter and Its Tangent Give the Numbers to Be Used for the Side Cut of the Jack Rafter.

Length of Hip Rafter

On a square-cornered building we find the length of the hip rafter by solving for the hypotenuse of the right triangle, made by the run of the hip and the rise. This can also be done on the hexagon or on the octagon roof. As an example, we will assume that the roofs shown each have a rise of 10 feet.

The length of the hip rafter for the hexagon roof will be the square root of ($\text{run}^2 + \text{rise}^2$). The run of the hip for the hexagon we have found to be 83.16 inches or 6.925 feet. The length of hip, therefore, is $\sqrt{6.925^2 + 10^2} = 12.164$ feet $=$ 12 feet 1 15/16 inches. The total run of the octagon hip rafter is 77.94 inches or 6.495 feet. The length of the octagon hip is equal to $\sqrt{6.495^2 + 10^2} = 1.92$ feet $=$ 11 feet 11 1/32 inches. The length of the octagon hip and jack rafter may also be found by the length per foot run method, taking the length per foot run from tables.

Cutting the Hip Rafter

The plumb and seat cuts of a hip rafter are always obtained by taking the "run of the hip per foot run of common rafter" on the blade and the rise per foot run on the tongue.

The roof illustrated has a total rise of 10 feet and a 6-foot run. This makes $120 \div 6 = 20$-inch rise per foot run.

The cut of the hip rafter for the square-cornered building then would be 17 and 20.

The cut of the hip rafter for the hexagon roof would be 13⅞ and 20, and the cut of the octagon hip would be 13 and 20.

Problems

1. A hexagon roof has a span of 16 feet. What is the length of the plate on a side?
2. What is the total run of the hip rafter for the roof in problem 1?
3. If the total run of the common rafter on an octagon roof is 12 feet, what would be the run of the hip rafter?
4. What is the length of the plate for one side of the octagon roof of problem 3?
5. How long is the hip rafter for problem 3 if the rise is 6 feet?

Answers

1. We have found that the length of the plate is equal to the "tangent length per foot run" times the span in feet, therefore the length of plate for a hexagon roof with a 16-foot span would be $6.93 \times 16 = 110.88$ inches $=$ 9 feet 2⅞ inches.
2. The run of hip per foot run of common rafter is 13.86 inches and the run of common rafter is 8 feet. The total run of hip is $13.86 \times 8 = 110.88$ inches $=$ 9 feet 2⅞ inches. Note that the run of the hip rafter and the length of each piece of the plate are the same.
3. The total run of the hip rafter is $12.98 \times 12 = 155.76$ inches $=$ 12 feet 11¾ inches.
4. The length of one side of the plate is $4.97 \times 24 = 119.28$ inches $=$ 9 feet 11¼ inches.
5. The length of the hip rafter will be the square root of ($\text{the run}^2 + \text{rise}^2$). The run of hip is 155.76 inches $=$ 12.98 feet. Therefore the length of hip $= \sqrt{12.98^2 + 6^2} = \sqrt{204.4804} = 114.299$ feet $=$ 14 feet 3 9/16 inches.

Uneven Pitched Hip Roof

Problem: To find the lengths and cuts for a hip roof with two different pitches. The width of the roof in Fig. 38 is 16 feet, the total rise is 8 feet and the end rafter is 6 feet.

When framing this roof we would first cut the common rafters "A." As the roof is 16 feet wide the run is 8 feet. The rise is also given as 8 feet. The pitch, therefore, is $8/16 = ½$. A one-half pitch roof has a rise of 12 inches per foot run.

The length per foot run for the common rafter of a one-half pitch roof is 16.97 inches. The length, therefore, is 8×16.97 inches $= 135.76$ inches $=$ 11 feet 3¾ inches.

This length may also be found by measuring across the steel square between the points 8 on the blade and 8 on the tongue. We will find this distance to be nearly 11 4/12 inches. Therefore the length of the rafter must be nearly 11 feet 4 inches. Our calculations have shown it to be 11 feet 3¾ inches.

Another way to find the length of this rafter would be to solve for the length of the hypotenuse of the right triangle formed by the run, rise and length of the common rafter.

The run is 8 feet, the rise is 8 feet. The length must be

the square root of $(8^2 + 8^2) = \sqrt{8^2 + 8^2} = \sqrt{64 + 64} = \sqrt{128} = 11.31$ feet or 11 feet 3¾ inches.

The jack rafters D and C are spaced 2 feet on centers. The first one would be one-third of the length of the common rafter and the second rafter "C" would be two-thirds of the length of the common rafter. The rafter "D" is 1/3 of 11 feet 3¾ inches = 3 feet 9¼ inches. The rafter "C" is 2/3 of 11 feet 3¾ inches = 7 feet 6½ inches.

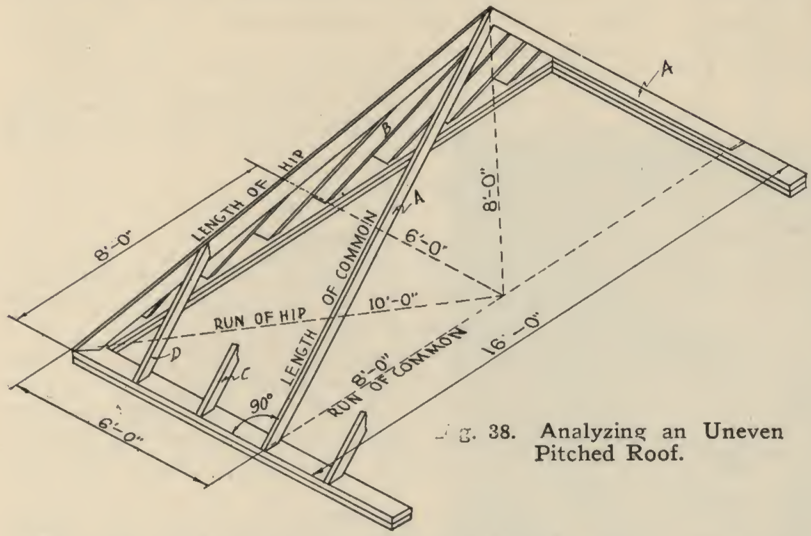


Fig. 38. Analyzing an Uneven Pitched Roof.

The common rafters and the jack rafters have the same seat cut and also the same plumb cut at the top. As the rise per foot run is 12 inches the numbers 12 and 12 will give this cut.

The side cut for these jack rafters is obtained as previously explained by taking the length of the common rafter on one arm of the square and the distance from the foot of the first common rafter, to the corner of the roof, on the other arm of the square. The length of the common rafter is 11.31 feet. The distance from the foot of the first common rafter to the corner of the building is 6 feet. The numbers to be used for the side cut of the jack rafter, therefore, are 11 1/3 and 6. The cut must be made along the arm on which the 11 1/3 is taken.

The common rafter "B" on the end of the roof has a run of 6 feet. The rise is 8 feet or 96 inches. The rise per foot run is $96 \div 6 = 16$ inches. This is a two-thirds pitch roof.

To find the length of this common rafter we use the square root method of measure across the steel square. By measuring across the steel square between the points 6 and 8 we obtain 10 inches. The length of this rafter, therefore, is 10 feet.

By the square root method we have:

Length of rafter $= \sqrt{6^2 + 8^2} = \sqrt{36 + 64} = \sqrt{100} = 10$, 10 feet.

There are three different lengths of jack rafters on this side of the roof. These are lettered "E," "F" and "G" on the plan and are spaced equal distance apart—that is, 2 feet on centers.

The rafter "E" is one-fourth as long as the common rafter "B" or ¼ of 10 feet = 2 feet 6 inches.

The rafter "F" is one-half as long as the rafter "B" or ½ of 10 feet = 5 feet.

The rafter "G" is three-fourths as long as the rafter "B" or ¾ of 10 feet = 7 feet 6 inches.

The plumb and seat cuts for these rafters are laid out by using the numbers 6 and 8 on the square, because the run is 6 feet and the rise is 8 feet; or we may use the numbers 12 and 16, because the rise is 16 for 12 of run.

For the side cut of the jack rafters we again use the rule as stated before: Take the length of the common rafter on one arm of the square and the distance from the seat of the first common rafter to the corner of the roof on the other arm.

The length of the common rafter is 10 feet. The distance from the foot of this common rafter to the corner of the building is 8 feet. Therefore the numbers 10 and 8 taken on the square will give the side cut of the common rafter. The cut is made along the arm on which the 10 is taken.

Our next problem is to find the length of the hip rafter. Previously we have learned of several ways to find the length of hip rafters for even pitched roofs.

The method that is most commonly used is to take the length of hip per foot run of common rafter from a table and multiply this length by the number of feet in the run of the common rafter. This method cannot be used in this case because there are no tables giving the length per foot run for hip rafters on uneven pitched roofs.

There are two methods that may be used. One is the square root method and the other is the method of measuring across the steel square. Both are based on the right triangle.

By inspection we will notice a number of right triangles, shown in Fig. 38. One right triangle is formed by the run of one common rafter, the plate and the run of hip.

Another right triangle is formed by the length of common rafter, the plate and the length of hip.

Another right triangle is formed by the run of the hip, the rise of hip and the length of hip.

As we have already found the length of the common rafter, we may find the length of the hip by solving the triangle formed by the common rafter, the plate and the hip rafter.

The common rafter at the end is 10 feet. The length of plate from the foot of this common rafter to the foot of the hip is 8 feet. The hip rafter forms the hypotenuse of the right triangle thus formed, and, therefore, the length of hip is the square root of $(10^2 + 8^2)$ or length of hip $= \sqrt{10^2 + 8^2} = \sqrt{100 + 64} = \sqrt{164} = 12.806$ feet = 12 feet 9 11/16 inches.

The length of the hip rafter may also be found from the other side of the roof using the length of the common rafter "A" which is 11.31 feet and the length of plate from the seat of this rafter to the seat of the hip, which is 6 feet, and solving for the hypotenuse of the right triangle thus formed. Length of hip $= \sqrt{11.31^2 + 6^2} = \sqrt{127.9161 + 36} = \sqrt{163.9161} = 12.803$ feet. This checks very closely with our first answer, which was 12.806. The last figure representing one-thousandth of a foot comes out different on account of dropping certain decimal places when taking the length of the common rafter.

Again we may find the length of the hip rafter by solving for the hypotenuse of the right triangle formed by the run of hip, rise of hip and length of hip.

To do this we first find the run of hip. This is the square root of $(6^2 + 8^2)$, or run of hip $= \sqrt{6^2 + 8^2} = \sqrt{36 + 64} = \sqrt{100} = 10$, or run of hip. Now the hip itself is $\sqrt{10^2 + 8^2} = \sqrt{164} = 12.806$ feet, or 12 feet 9 11/16 inches.

For obtaining the plumb and seat cuts for the hip we use the numbers 10 and 8 as the total run of the hip is 10 feet and the total rise is 8 feet. The side cut of the hip is a little more difficult to obtain.

The rule usually used is: "Take the length of hip on one arm of the square and the run of hip on the other arm."

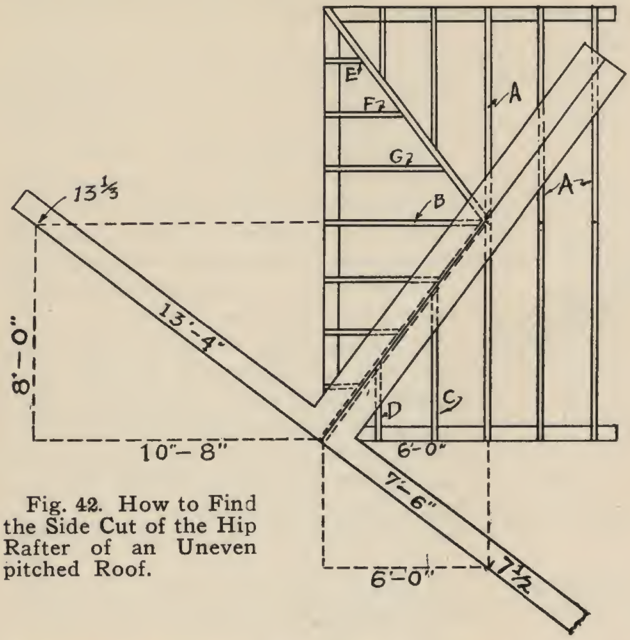


Fig. 42. How to Find the Side Cut of the Hip Rafter of an Uneven pitched Roof.

As explained previously, it is really the tangent to the run that is taken, but as this is the same as the run of the hip rafter, we usually state it as the run.

On an uneven pitched roof the tangent to the run is not the same as the run and, therefore, the above rule does not hold good. Fig. 39 illustrates two squares placed so as to indicate how the side cut for the hip may be found.

On one arm of the square we must take the length of the hip rafter and on the other arm the length as indicated in Fig. 39. This length may be found by laying out and measuring or by mathematical calculations.

The length of the hip rafter is 12.806 feet. The side cut on one side of the hip is 12¾ and 7½. The side cut for the other side is 12¾ and 13 1/3 (see Fig. 39).

Problems

1. A house 32 by 32 feet is to have a hip roof with a 2-foot ridge. How may this be accomplished?
2. The total rise of this roof is to be 12 feet. What will be the pitch of each side of the roof?
3. Find the length of the common rafters for each side.
4. What will be the length of the total run of the hip rafter?
5. Find the length of the hip rafter.

Answers

1. The rafters on two opposite sides of the roof must have a steeper pitch so that the rafters from these two sides do not meet in the center.
2. The pitch on two sides will be $12/32 = 3/8$. The pitch on the other two sides will be $12/30 = 2/5$.
3. On two sides the common rafter has a run of 16 feet and a rise of 12 feet. The length will be equal to $\sqrt{16^2 + 12^2} = \sqrt{225 + 144} = 19.209$ feet = 19 feet 2½ inches.
4. The runs of the hip rafter will be equal to the diagonal of a rectangle whose sides are 16 and 15 feet. Run of hip = $\sqrt{16^2 + 15^2} = \sqrt{256 + 225} = \sqrt{481} = 21.931$ feet = 21 feet 11 3/16 inches.
5. The length of the hip rafter is equal to the square root of (the run squared plus the rise squared) = $\sqrt{21.931^2 + 12^2} = \sqrt{480.968761 + 144} = \sqrt{624.96876} = 24.798$ = 24 feet 9 9/16 inches.

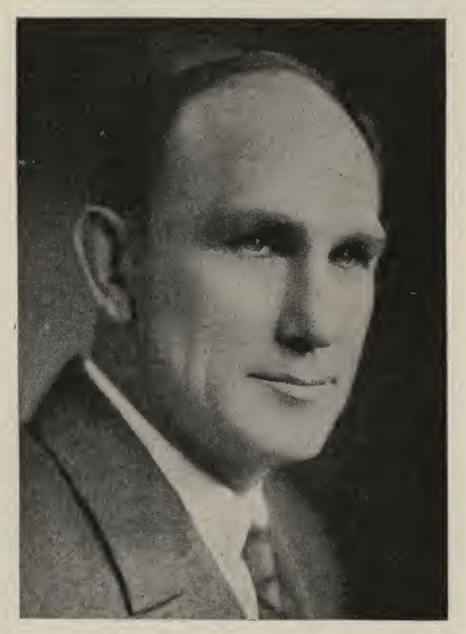
An Example of Unusual Roof Construction. This North Woods Log House Follows a Design Which Has Been Skillfully Handled to Harmonize with the Rustic Setting. It Is a Summer Home in Which No Item of Comfort for Year Around Residence Has Been Neglected.

End-Matched Soft Wood Flooring and Lumber

END-MATCHED softwood flooring, such as yellow pine, is on the market commercially; and, despite whatever resistance might be offered to its use by those who always lag behind, it is gaining ground so rapidly that the alert contractor and builder is taking cognizance of it.

End-matched flooring is that flooring which has a tongue at one end of the piece and a groove at the other—just the same as side-matched flooring. End-matched hardwoods are not new. There is not a contractor or builder who has not used and is not using end-matched hardwood floorings, because hardwood floorings are end-matched. It is the general custom.

It has been twelve years since one of the southern yellow pine mills started end-matching some of its flooring. And during that twelve-year period it has not stopped. Within the past year a number of other southern yellow pine mills have installed machinery for end-matching, and there is every promise that the coming year will see twice the present number of installations.



J. F. Carter, Field Man and Expert on Merchandising of Short Lengths for the Southern Pine Association.

It must be seen that the idea of end-matching yellow pine flooring is really not a new thing. It has gone through all the experimental and the test stages. And, because the new spirit of organizations of manufacturers is so strong today, all the kinks and errors which have been made by one company have been truthfully transmitted to all other southern yellow pine mills so that the errors once made will not be made again. Thus, we see that as the increased manufacture of end-matched flooring takes place the buyer need have no fear of the things which may have occurred ten years ago.

Why should the contractor or builder accept end-matched yellow pine flooring?

Because it will make him money in his business.

That is a good reason.

The manufacture of end-matched flooring saves money for the sawmill man—by permitting him to cut out defects—thus raising the grade of the piece, permits him to ship odd lengths, and permits him to ship much shorter lengths than were shipped in standard butt-end flooring. It means real conservation; a greater footage of manufactured material is sold from the log; a greater profit is made from the single log; and this means, in the long run, a lower price.

When the contractor purchases butt-end softwood flooring he suffers two losses; one is the 8 or 10 per cent additional flooring which he must buy to be wasted by cutting off; and the other is the loss of time in sawing to meet joists, or in squaring the two butts to meet when he is laying on a sub-floor.

Short lengths of end-matched yellow pine are a tremendous saving to the contractor and builder. In the first place he can purchase the short lengths at a considerably lower price than the standard lengths, whether butt-end or end-matched. Secondly, there is no wastage in sawing, not a bit. The only time a piece of end-matched pine flooring is sawed is at the end of the run across the room, and the piece sawed off is brought back to start the next run. So that, the only possible piece of waste by sawing off is that piece left when he has finished the entire house.

The third saving is in the labor of sawing. The fourth saving is that he does not have to lose time making a careful face nailed job, for there is no face nailing.

The fifth saving (to someone) is that the finishing or scraping of end-matched yellow pine flooring is not as costly as the same procedure on butt-end flooring.

The next consideration is that the job is a better looking one because there is no face-nailing, and there will be no squeaks caused by the loosening of such face-nails.

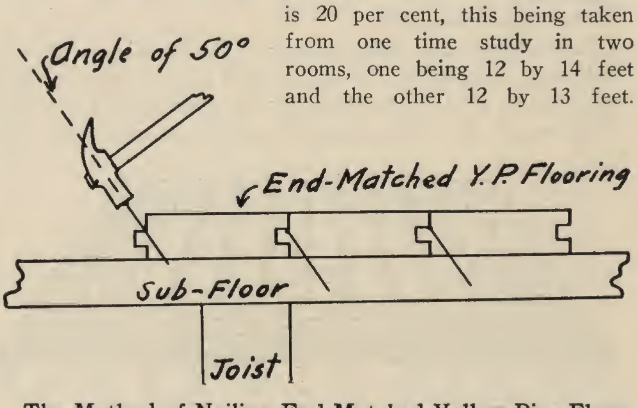
Just at this point let us present some rough figures to illustrate what the contractors save by using short lengths of end-matched yellow pine:

First, the mills make a considerable differential in price on short lengths end-matched—in some cases as much as $15.00 per 1,000 feet. Of this, it is fair to be assumed that the retailer will pick up $5.00 of the differential and permit the contractor or builder to have $10.00. I say this is "fair to be assumed" because I have talked to several retail lumbermen concerning this point.

Secondly, the 8 or 10 per cent excess which has always been figured by the contractor is not purchased—there is no need of it because there is no such waste.

Thirdly, there is a saving in time of 25 to 40 per cent in the use of end-matched yellow pine flooring as contrasted with butt-end. The lesser saving comes when the short length end-matched is being laid over sub-floor and the greater saving comes when the flooring is being laid directly on joists without a sub-floor. This saving in time is a very large item, and one time study after another, with scores of letters from contractors, attest to the value of short-length end-matched flooring.

Fourth, the saving in sanding or scraping an end-matched yellow pine floor as against a butt-end pine floor is 20 per cent, this being taken from one time study in two rooms, one being 12 by 14 feet and the other 12 by 13 feet.



The Method of Nailing End Matched Yellow Pine Flooring When Laid on a Sub-Floor. Nails should be about six or seven inches apart.

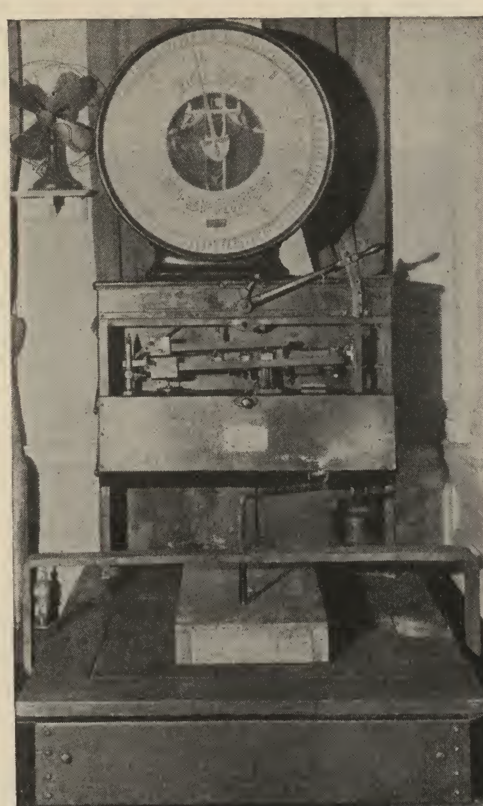
The contractor can take these four points and reduce them to dollars and cents on any of his jobs. They will work out perfectly, in the event they do not show him even a greater saving than is cited in the foregoing.

How about obtaining end-matched softwood flooring?

The actual fact is that the contractor will not be able to call on every retail lumber yard and obtain the item at once. This is because the retail lumberman is not a merchandiser. The only seller of a product who is a poorer merchandiser than the retail lumberman is the sawmill man or manufacturer. It is truly lamentable in this age of sharp competition that no more merchandising principles have been applied by the manufacturers of lumber.

The retail lumberman waits for the demand, then he orders his lumber. The contractor will probably find this true of end-matched yellow pine flooring. But this defect will be cured within a few months. The propaganda for the use of end-matched yellow pine flooring is strong and spreading rapidly, carrying with it, too, the feature of short lengths.

What do I mean by short lengths? I mean end-matched flooring in pieces from 2 to 8 feet. These are the bundles on which the retail lumber yard, and the contractor or builder, get their differential. And these are the lengths in which the really large savings are made in laying, whether over joists or sub-floor. It will be surprising to contractors who are not initiated when they discover how much flooring one man can lay if the item is short-length and end-matched.

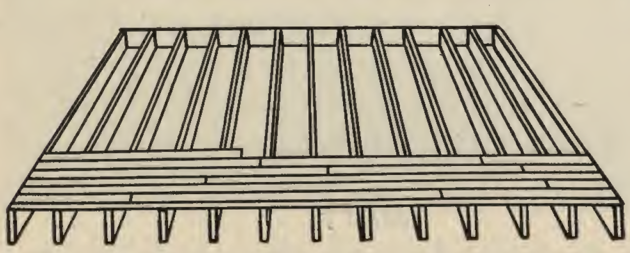


Test for Strength Being Made on a floor of End Matched, Yellow Pine, Laid Directly on Joists, Without Sub-Floor. This Floor is bearing a strain of 990 pounds to the square inch and has not failed. In this case the dial showed 1,175 pounds when the floor failed. This is more than any household load.

One of the arguments, perhaps, will be that too many breaks show in such a short-length floor. It is quite true that many breaks show. But rear hall, kitchens, pantries, bedrooms, and other such rooms are among those in which it does not matter so much that a great number of breaks show. The strength is still there, the finish is there, a saving in purchase price exists, and a saving in labor in laying and finishing is certain. Rear porches are among those which might be included.

How about strength?

Naturally, such a question does not arise when a floor is laid over a sub-floor. The only time it can arise is when the flooring is to be laid directly on joists. Will the floor be strong if the end-match falls between two joists? The answer is strictly an affirmative—without reservations.



End Matched Flooring Laid Directly on Joists. No attention need be paid to the location of joists when matching.

Joists are spaced on 16-inch centers. Therefore, the purchase of short-lengths, since it includes 2 feet as the shortest piece, will not include anything which will not be nailed on a joist at some part of its length.

But—here is the way in which strength has been tested: Specimen floors were made in which one piece of end-matched yellow pine flooring was 6 inches long. This piece was so placed that it fell squarely in the center of the space between the joists, so that it could not be nailed to anything, so that nothing but the side and end matches were holding it.

The pressure on top of the floor was brought to bear in the center of this 6-inch piece, a situation which, in practice, would rarely occur. The first floor tested failed at 785 pounds per square inch (the testing bearing was a square inch) and the failure was not at either the side or end matching of the small unsupported piece, but was in another piece nearer to a joist. The second floor failed when 900 pounds per square inch were brought to bear on the short unsupported piece. There was no sub-floor. This test was to show strength when laid directly on joists.

The strength of any one piece depends on the angle of the grain and the texture of the wood, but the evidence produced in the tests are conclusive that short end-matched yellow pine flooring regardless of grade can be used without sub-floor, letting the joists come where they may, without being supported by joists, and it will withstand more than any reasonable household load.

Although these tests have shown the strength which short end-matched flooring has, I would not suggest that floors be laid without sub-floors. Sub-floors carry several insurance features. One is that the strength of the structure is greater when a sub-floor is laid diagonally; another is that the room is better insulated; and a third is that the floor is more sound-proof. Of these, quite obviously, strength of the structure as a whole and the insulating qualities are important.

End Matching No Experiment

Contractors and builders are accustomed to purchasing and using hardwood floors in short lengths and end-matched. They should do the same with softwoods. In yellow pine flooring there are two faces, one rift or quarter sawed and the other plain or flat-grain. The rift or quarter sawed, or edge-grain, yellow pine is a far prettier and better floor than is the flat-grain, more durable and finishes better. But the finish or the durability are matters of choice with the builder. In my opinion, and in the opinion of many contractors who are using short length, end-matched flooring of yellow pine, there is no choice, it should be used.

For many years hardwood flooring has been end-matched—that is, having tongue and groove on the ends of the pieces. Unless he buys the very thin hardwood flooring, the contractor or builder never thinks of its being anything

other than end-matched. End matching is standard.

About twelve years ago one of the southern pine mills began the manufacture of end-matched yellow pine flooring. It was a long, hard, uphill fight, that of getting this item introduced. Though the dealers in lumber, the contractors, the builders and even architects and consumers recognized and accepted end-matching of hardwood flooring, they offered resistance to the end-matching of yellow pine flooring.

Today a large number of southern mills manufacture the end-matched flooring, and each of them, in its own way, is publishing selling propaganda which illustrates to the retail lumber dealer and to the contractor or house-builder that there is money to be saved by the use of end-matched yellow pine flooring, more especially in the use of short lengths.

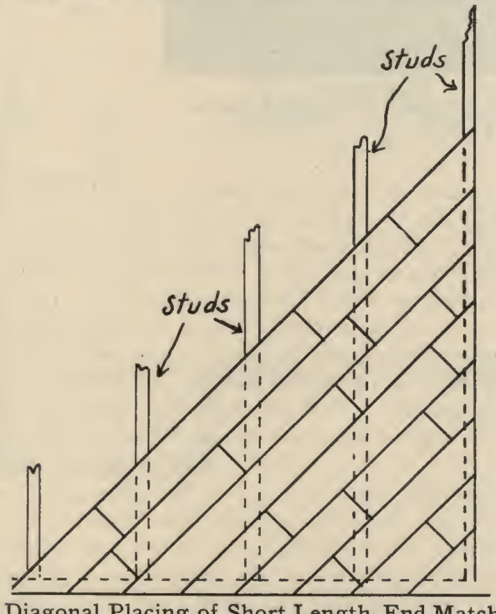
But how about any resistance which might be offered to the use of yellow pine ceiling, sheathing, drop-siding and even common boards end-matched? Has the contractor, or the architect, or the retail lumberman, or the average house-buyer, thought of the wonderful saving (by saving I mean money) in the use of short length end-matched ceiling, sheathing, drop-siding and boards up to 10-inch width?

There are many, I know, who will reject such an idea. But it must not be rejected, and is not going to be rejected.

Let us view it, for a moment, from the angle of sound merchandising. When any of the substitutes for lumber commenced planning the inroads it must make on the lumber market, it did not sell on price; only a few of them actually sold on superior merit as a talking point. But they did use "waste" as their selling argument. And they use it yet. They will continue using it.

Waste means money loss somewhere—and that somewhere is always, and ever will be, the ultimate buyer or owner. Waste bores more holes and deeper holes into pocket-books than any other one item in existence. The men who were merchandising a substitute for lumber knew they had a good talking point in the use of the word "waste," for they could draw pictures of it, could describe it, could calculate it in dollars and cents.

New Employees Hotel at Pine Valley, Oklahoma (a New Saw Mill Town), in Which Every Piece of Ceiling, Siding, Flooring and Partition Is Short Length, End Matched, Yellow Pine.



Diagonal Placing of Short Length, End Matched Sheathing on Studs. Each piece has a bearing at some point and can be nailed to a stud. Visualizing the studs as joists shows the use of this material as diagonal sub-floor. Note the decreased need for sawing and also that the piece sawed off the run at the right end can be brought back to start the run at the left.

But the sawmills manufacturing lumber never got down to merchandising until recent years. I might say recent months. Had they been merchandising their product, had they given proper thought to the changes which are constantly taking place in the social fabric, the manufacturers of substitutes would never have gained the strong foothold on the building material market which they enjoy today.

Is there really any advantage in the use of ceiling end-matched and in short lengths?

Most assuredly there is. The first advantage, of course, is to the manufacturer, the sawmill. His waste will be lowered very, very much. The next saving is to the retail lumberman, and the third saving is to the man who builds the house. Whether it be a chicken house, a barn or a dwelling, the use of short length, end-matched ceiling, drop-siding, and sheathing will effect what might easily be termed a gigantic saving.

When using these items of lumber the average farmer or contractor or house-builder purchases the standard lengths —which are in multiples of 2 feet; that is, 10, 12, 14 and 16 feet long. The careful laborer has to square-saw the two butting ends of a piece of ceiling or drop-siding at the point where it meets the center of the stud. What is done with the piece sawed off? It is allowed to become waste ordinarily. That waste amounts to 10, 12 and as high as 15 percent. That is a real money loss. It is far too much. Yet the habit is to lose it.

If end-matched ceiling and drop-siding are used, the end of a piece which juts over a stud is not sawed off. Instead, the next piece is matched into the end, the tongue slipping into the groove, and the run continues. The only piece sawed off is at the end of the run, where a door or window is met, or at the side of the house. What is done with the piece sawed off? No matter how small it may be, it is taken back to the start of the next run, nailed on the stud, the piece end-matched in, and the run continues. The only piece wasted is the very last piece cut when the entire job is finished.

How about strength?

It has been determined that with the end-matched pieces the run is stronger than the same run made from butt-end-pieces nailed at the ends on the studs. Even though the "break" or matching comes between two studs, the run is

stronger and will bear a great deal more stress from wind or other source of shock.

In diagonal sheathing (and certainly this is the preferred method of putting sheathing on a house) the saving in material and in time is very great. At the present time the piece used as sheathing lumber is sawed at an angle of 45 degrees at a stud. Then another piece is sawed at the same angle and is nailed to that same stud. By the use of end-matched lumber for sheathing, such time-wasting cutting is not needed. The run continues as if the piece were one long board. When a window or door or the side of the house is reached, the carpenter cuts the piece at an angle of 45 degrees to line up with the studs, but he does not throw away the cut off. He walks back to the start of the run, where he would have to saw a 45 degree angle anyhow, and nails the piece on, matching in the next piece at the end, and continuing the run.

No actual time study or figures are in my hands, but I dare say, after an experience with end-matched short length yellow pine sheathing, that the saving in time (and that is money) is greater than when laying the flooring item. That is, the saving should range between 25 and 50 per cent. This statement has been questioned by one or two parties, but I yet believe it is true.

Someone may raise the question as to appearance.

The appearance of a job of end-matched lumber is far better in every case of reasonably good work than is the and going down even to 12-inch length. A 12-inch piece of ceiling, flooring, drop-siding or sheathing must not frighten anyone—entire houses have been built of it. It lays up as readily for the builder as blocks do for a child on the floor. The matching is the thing.

The day is not far distant when common boards, 8, 9 and 10 inches wide, will be end-matched—and when that time comes (the contractor can help to make it come more quickly by continually asking for it) better construction will be the rule, and a less amount of money will need to be expended.

End-matched items such as those mentioned herein have been made by several of the Southern pine mills making yellow pine lumber and, since the installation of the machinery has already been made, the contractor, the builder, architect, etc., can get these items by calling on the retail lumberman to supply them.

Are they already in stock in the yards of the retail lumberman? They are not. The retail lumberman believes in the path of least resistance. He has been nursed to this by the manufacturers of substitutes for wood. They have advertised their items heavily, making it easy for the retail lumberman to sell, without any merchandising effort on his part.

Will the lumber manufacturer, the sawmill, follow the lead of the substitute manufacturers? He has not thus far. He is satisfied, evidently, with allowing the retail lumberman to send in orders as stock is needed. He puts the merchandising up to the retail lumberman.

Building at Florala, Alabama, Constructed Entirely of Short Length, End Matched, Yellow Pine

better grade of job done with butt-matched lumber—if for no other reason than that the average carpenter cannot cut butt-ends to match up as well as machinery does the squaring and end-matching. After the paint has been placed on the job, the average end-matched piece of work is very much superior to even the best butt-end job.

There is yet another advantage gained by using these items end-matched—that is insulation. Closely tapped up pieces of end-matched stock leave no openings, whereas even a high-grade butt-end job shows many openings.

Sub-floors come in for discussion. Sub-floors should be laid on every dwelling job that is a well-built job. The material for sub-floors, laid at a 45-degree angle to the joists, should be end-matched. Again there is a saving of material, a saving in time of laying, a stronger piece of construction, the first two meaning actual cash money.

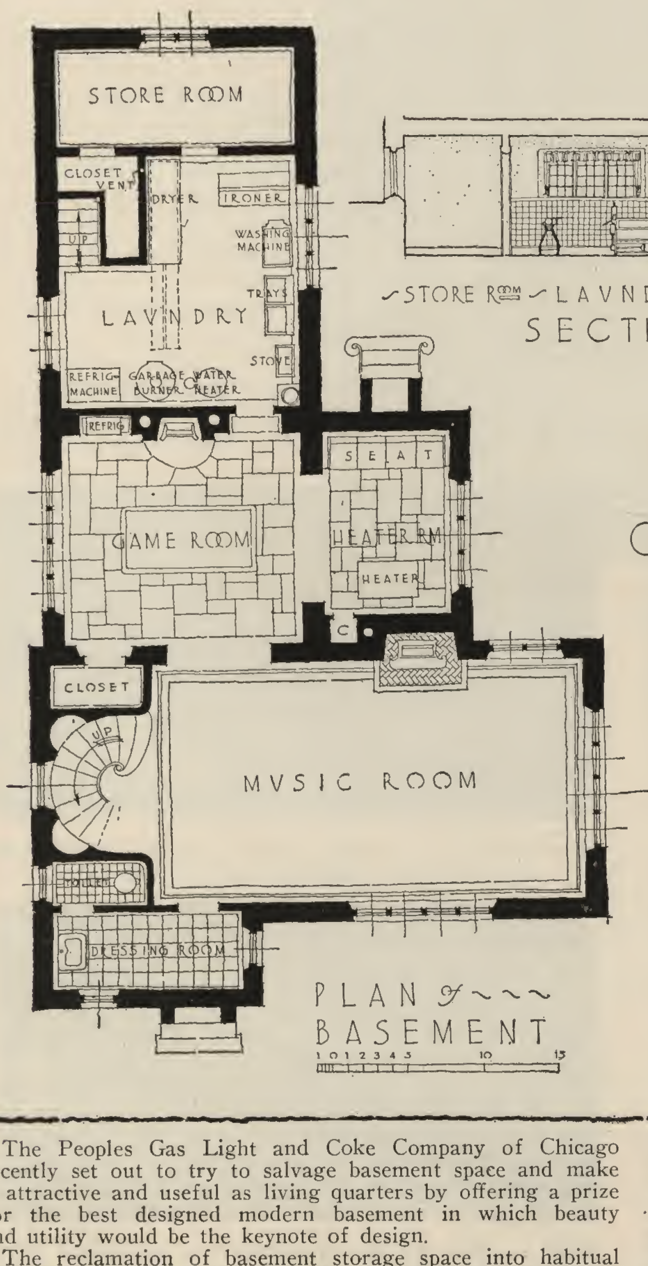
Short length, end-matched material must receive attention because it can be bought for less money than standard lengths, lays up faster, makes just as fine a job as standard lengths, and gives just as great structural strength to the average small dwelling job. By short lengths I mean end-matched lumber less than 8 feet long

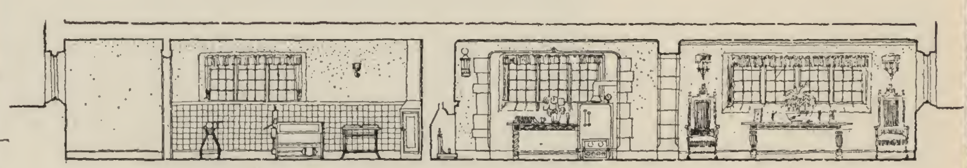
Hence, if the architect wishes to build a stronger house, a better insulated one and a lower-cost one for his client; if the contractor wishes to make a few more dollars on his contract; or the house-builder wishes to have a better house at a lower cost, the use of short length, end-matched items such as flooring, ceiling, sheathing, sub-flooring and drop-siding is the way. And the next thing necessary is to demand these items from the retailer so often that he finally orders.

In presenting these discussions of end-matched items, I am trying to show the architect, the contractor and the house-builder where money can be saved and a better piece of construction obtained in the use of wood. If the reader desires to accomplish these savings he must demand the items from the retail lumberman.

Here and there, at least I hope, there will be retail lumbermen who will see the opportunity to make more money, carry a smaller stock, have a quicker turn-over, and sell actually more lumber by laying in stocks of end-matched yellow pine.

PERSPECTIVE IN MVSIC ROOM

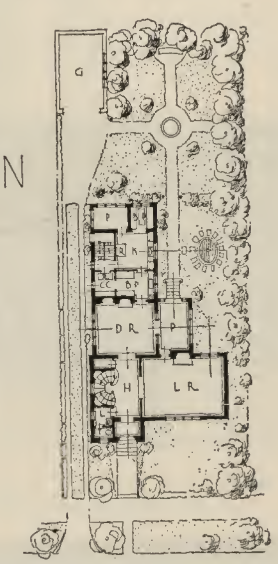




STORE ROOM — LAVNDRY — GAME ROOM — MVSIC ROOM

SECTION THRV BASEMENT

1 0 1 2 3 4 5 10



PLAN of FIRST FLOOR

The Peoples Gas Light and Coke Company of Chicago recently set out to try to salvage basement space and make it attractive and useful as living quarters by offering a prize for the best designed modern basement in which beauty and utility would be the keynote of design.

The reclamation of basement storage space into habitual parlors and rooms is made possible by the installation of a gas-fired central heating plant. The competition for the prize arrangement provided that a central, gas-fired house heating plant, together with hot water service, refrigeration, laundry washing, drying and ironing, should all be taken care of in a practical manner, leaving the remainder of the basement space to be turned into an attractive room or rooms for recreation, rest or entertainment. The size of the lot specified upon which the building was to stand was 50 by 125 feet.

First prize design is illustrated.

Pointers on Framing Wood Joist to Steel Beams

IT has become common practice now to use steel floor girders in small buildings. Steel beams have the advantage over heavy wood sections in that they may be depended on to carry heavy loads and at the same time be of comparatively small cross section. Steel columns have come into favor also for the same reason.

Where clear spans of large area are required and it is permissible to block the clear space with an occasional column, the ideal type of framing, unless fireproof construction is to be used, is the wood joist floor supported on steel columns and girders. When this construction is used, some means is necessary to hold the wood joists to the steel beam, and here the contractor has the choice of several different methods.

Probably the least expensive method for seating the joists is that shown in the illustration in Fig. 1, and the sketch in Fig. 5. This is the use of a wood cleat bolted to the web of the beam. When the beam is ordered from the shop the specifications should call for a certain number of holes in the web, and the spacing and location of the holes should be given. Then when the beam comes on the job it is delivered with the holes already punched, and the wood shelf angle may be bolted to it by the carpenters on the job.

Another method commonly used is to carry the joists on a shelf angle attached to the web of the beam in the fabricating shop. This is illustrated in Fig. 2 and Fig. 7. The size of the angle to be used depends upon the weight the floor is called upon to carry, in other words, the heavier the floor load the larger the shelf angle should be. It is good practice to use an angle with unequal legs allowing the long leg to project from the face of the beam web, thus affording a larger bearing surface for the joists than if equal leg angles are used. Nothing less than a three inches by three inches angle should be used, however, or the joists will not have sufficient bearing.

In situations where there is plenty of headroom, and it is considered advisable to take headroom from the lower floor instead of the upper, the method shown in Fig. 3 and Fig. 6 may be used. This consists of attaching a steel plate to the lower flange of the beam and allowing the joists to rest upon the plate.

When this is done the plate should be allowed to project for at least three inches beyond the edge of the flange so that three inches of bearing may be assured for the joists. It is never safe to assume that the joists will take bearing both on the flange and on the plate. To make this possible careful cutting would be required, and even then, shrinkage of the joists would cause them to bear too much on the flange or too much on the plate, with insufficient bearing on each.

It is safe, however, to assume that the joists take bearing on the flange if at least three inches of bearing is provided on the plate, for then, if the joists do not take bearing on the flange of the beam there is sufficient bearing for them on the plate. If they do take bearing on the flange, well and good, they will be so much more stable.

When extremely heavy beams are used for the girders, it is possible that their flanges may be so wide as to furnish sufficient bearing for the floor joists without providing any auxiliary means of support for seating them. In this case the joists may be carried upon the flanges of the beams as illustrated in Fig. 9. As in the other cases, at least three inches of bearing should be provided.

When joists stop at steel beams and it is possible to allow the beam to project into the room below, they should be treated as illustrated in Fig. 8. These joists are notched,

Fig. 1. Method of Framing Wood Joists to a Steel Beam by Means of a Wood Shelf.

Fig. 2. Method of Framing Wood Joists to a Steel Beam. Note that the joists are tied to each other.

Fig. 3. Floor Joists Framed to a Steel Girder by Resting Them on a Plate Attached to the Under Side of the Bottom Flange of the Girder.

Fig. 4. This Is Not a Good Way to Frame Wood Joists to a Steel Beam for Reasons Which Are Fully Explained in the Text.

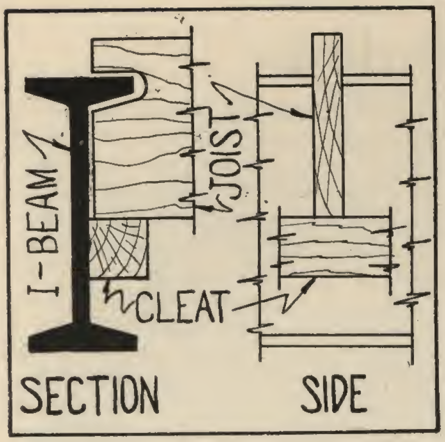


Fig. 5. Wood Joists Resting on Wood Cleat Bolted to Web of Steel Beam.

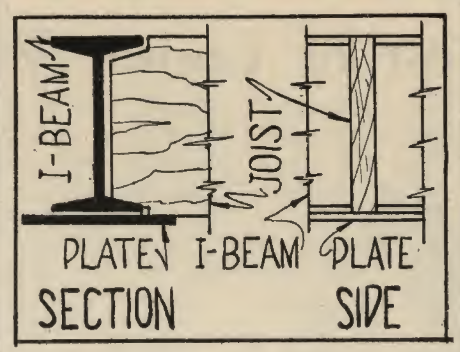


Fig. 6. Wood Joist Resting on Steel Plate Attached to Under Side of Lower Flange of Steel Beam. This method is suitable for situations where there is considerable head room that can better be spared from the lower floor than from the upper.

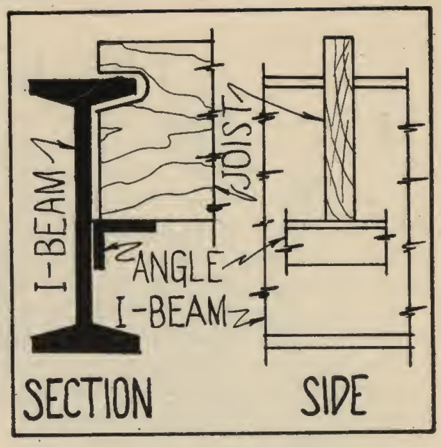


Fig. 7. Wood Joist Resting on Steel Shelf Angle Riveted to Web of Steel Beam.

to fit over the top flange of the beam instead of merely being set down on the beam without any further consideration. Notching the beams in this fashion provides a means of locating them permanently in place with the assurance that there will be not further danger of their shifting.

Joists which are supported at some point in their length by steel beams may be handled as shown in Fig. 10, but where two joists, which are carried on the upper flange of a beam, lap at the beam they should be framed in the manner shown in Fig. 11. The lap should be at least six or eight inches long and several nails should be driven into the joists at the lap in order to tie them together.

Fig. 8. Joists Coming to an End at Steel Girder Should Be Handled in This Fashion to Provide Greatest Stability.

Joists should never be framed to steel beams in the fashion illustrated in Fig. 4. Here a notch was cut in the end of the joist and set to engage the shelf angle on the web of the beam. It would have been just as easy to have ordered the beam with the shelf angle placed low enough so that the joists could have their lower edges resting upon it. Fig. 4 illustrates a dangerous condition The joists are very liable to crack at the point where they are attached to the beam thus weakening the entire floor system.

It may be well also to give a word of caution regarding the method of cutting the joists at the ends when the type of framing used demands that they project above the top flanges of the beam as is the case in Figs. 1 and 2 and illustrated by the sketches in Figs. 5 and 7. Refer to Fig. 5, which is a typical case and note how the joist is cut where it fits over the top flange of the beam.

There should be plenty of room (at least one-fourth inch clearance) between the beam and the end of the joist in order that provision be made for expansion and settling, two factors often overlooked. If sufficient clearance is not provided the expansion of the joist or settling of the building may result in a cracked joist or a warped floor. This kind of cut is best made by drilling an auger hole at the proper distance back from the end of the joist and making two saw-cuts to the hole.

Where steel shelf angles or plates are ordered they should be riveted to the beams in the fabricating shop rather than bolted to them on the job, as riveting makes a much stronger job. When wood shelf cleats are used they should be tightly bolted to the beam, and washers used on the bolts so that a good, tight job is assured.

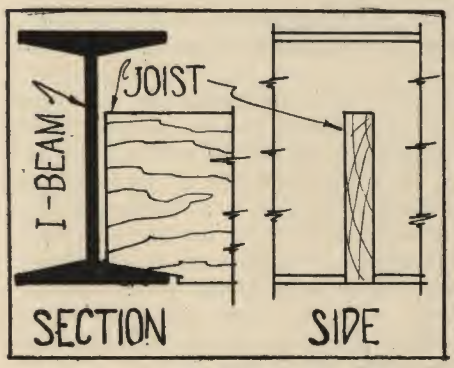


Fig. 9. Wood Joist Resting on Flange of Steel Beam Where Heavy Beams with Wide Flanges Are Used.

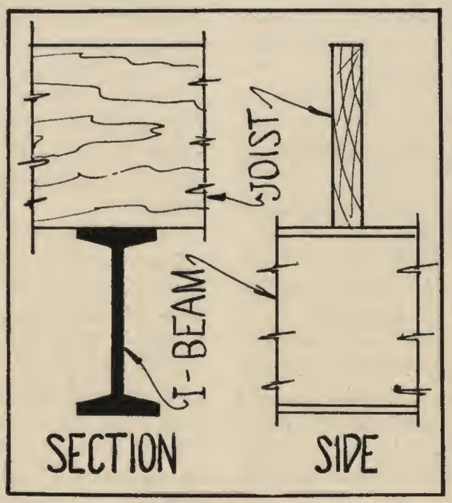


Fig. 10. Wood Joist Resting on Steel Beam. In this case the beam is an intermediate support.

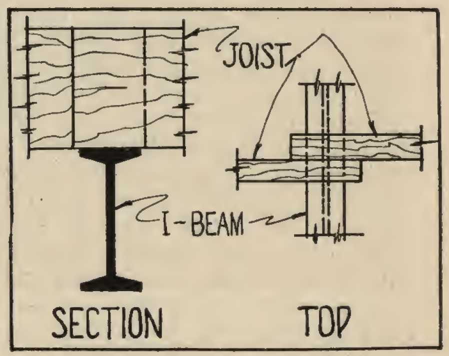


Fig. 11. Wood Joist Resting on Top of Steel Beam. The joists are lapped and fastened together with a few nails.

The Cost of Loose Windows

PUTTING a price on the size of window cracks and reducing to pounds of coal and dollars the looseness of loose windows—this has been done in a way to encourage every builder who has advocated and used storm sash and weatherstrips in the building of new homes or larger buildings. Authoritative tests under different wind pressures have shown that loose windows cost much more than most home builders realize; even more than practical contractors have estimated in the past.

The Research Laboratories at the Bureau of Mines in Pittsburgh now have reported results of tests made under supervision of the American Society of Heating and Ventilating Engineers in a way to be most useful to home owners and builders. F. C. Houghton, of New York City, and C. C. Schrader, of Pittsburgh, conducted the tests and embodied their appraisal of window cracks as a liability in a report: "Air Leakage Through the Openings of Buildings." No such proof heretofore has been available of the importance of reducing the loss of heat outgoing and of the result of infiltrated cold.

Many of the conclusions are startling. Summarized the report serves to show:

That one plain unlocked window without weatherstrips and with cracks 1/16 to ¼ inch wide, having a perimeter of about 18½ feet, costs no less than 1,357 lbs. of anthracite coal during the heating season.

That the locking of windows with good hardware serves materially to reduce the loss of heat.

That weatherstrips of two general types—such as are produced by many manufacturers in varying quality and values—when the crack is ¼ inch reduce the window fuel cost from 1,357 lbs. to 531 lbs. and 295 lbs. respectively. When the crack averages 1/16 of an inch the fuel cost is reduced to 266 lbs. in one case and 207 lbs. in another when the average wind velocity is 14.4 miles per hour—the average prevailing in a large part of the United States. When the average wind pressure is as high as 24.9 miles per hour, according to this report, the costs are as follows:

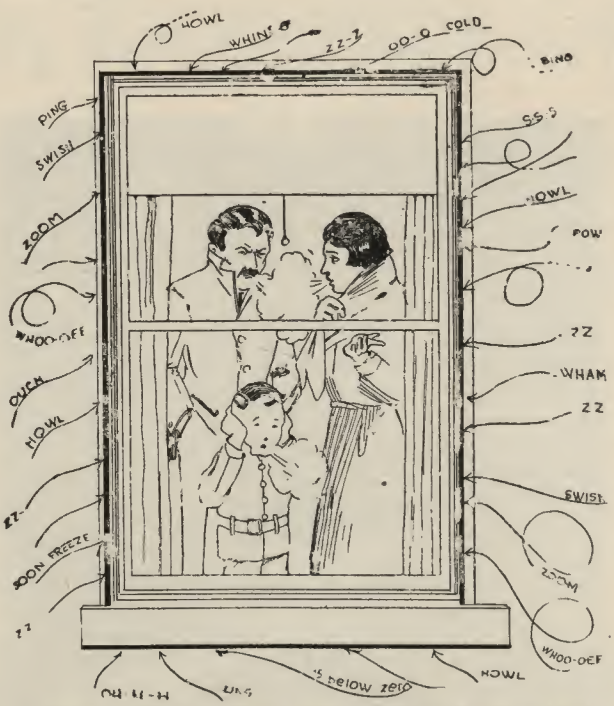
Plain window, unlocked, cracks 1/16 to ¼ inch, fuel cost per season, 2,215 lbs. of anthracite.

Same window improved by ribbed type of weatherstrip shows fuel cost reduced to 1,062 lbs.

Same window equipped with an interlocking type, when new, shows reduction of fuel cost to 605 lbs.

When the window cracks are 1/16 instead of ¼ inch the ribbed stripped window shows a fuel cost of 590 lbs., the interlocking stripped window 472 lbs. of anthracite.

Stated in another way the report shows that a window crack 1/16 to ¼ inch, when not weather stripped or protected with storm windows costs for a heating season 310 lbs. per running foot. When the same window wears a ribbed type of strip the cost per foot is 74.7. When the interlocking type is used the cost per foot is reduced to 41.4 lbs.



Winter Winds That Enter Through Uncalked Window Frames Amount in Coal to 75 Pounds Per Foot of Crack ¼ Inch Wide Where Average Winds Are 15 Miles Per Hour.

These tests have had comparison with actual results ascertained in about 100 buildings and the results so far as the plain window and the window ribbed type of weather strip were verified by experience. The Code prepared by the Society of Heating and Ventilating Engineers for adoption or final revision at the annual meeting expressed the comparative heat losses when subjected to a 15-mile wind, as follows:

Plain window 47.5 cubic feet per minute of cold air.

Window with interlocking type of weather strip 7.8 cubic feet per minute of cold air.

We have throughout this article translated this lingo of the engineer to the equivalent quantity of coal needed to produce the heat displaced by the incoming cold air. The comparisons are these:

B.t.u. loss per hour under 15-mile wind—

Plain window 2,500 B.t.u. equals 1,357 lbs. anthracite.

Ribbed type weather stripped windows—1/16-inch crack, 488 B.t.u. equals 266 lbs.

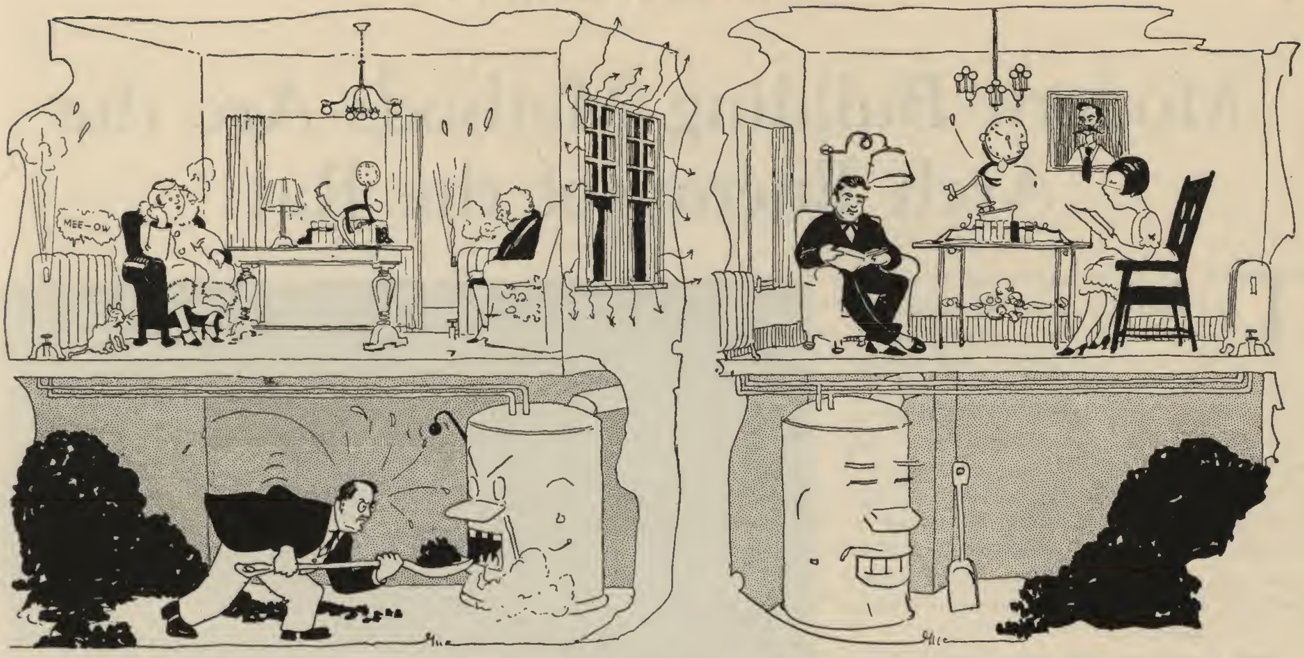
Interlocking weatherstrip, 1/16-inch crack, 380 B.t.u. equals 207 lbs.

The new Code specifies that in computing "window losses" only half the windows shall be considered and these figures shall be reduced by 20 per cent, an important revision.

"It is a curious fact not generally understood," said an engineer, who is one of the country's foremost authorities on air leakage at windows, "that we find every home is surrounded with an envelope of warm air passing outward at a rate to offset a 6-mile wind. This we call exfiltration—outward pressure of expanded warm air escaping from windows, and it is only when wind exceeds 6 miles an hour that it drives through the enveloping warm air and enters through window cracks as well as through the cracks around the window frames. This outward pressure of expanded air causes a continuous loss and a heavy loss when the windows are at all loose, as most windows are. So it is evident that weather strips are even more useful to a building owner than the data on infiltration goes to show. The cold air which is driven in has been accounted for; there is in addition a constant loss by exfiltration which must be considered."

The country over, it has been found that the wind velocity averages 13 miles per hour, that the window cracks amount to 1/16 inch, and that the use of weatherstrips reduce the air leakage by 4/5ths to 8/9ths of the usual air leakage. With these facts in mind it is as interesting as a cross word puzzle to estimate the total number of billions of dollars which annually go to waste from the 26 million homes in the United States as a result of air leakage.

Prof. J. D. Hoffman, of Purdue University, gave this as an illustration of what it means to the coal piles in millions of homes throughout the country:



In the House with Uncalked Windows Only the Man Who Stokes the Furnace Can Keep Warm, as the Warm Air Leaks Out and the Cold Winds Blow in, But with Weatherstripping Installed Everyone Is Comfortable and Even the Furnace Wears the Smile That Comes from Handling Its Job with Ease.

Take a 3-window living room 13 by 15 feet and a 10-foot ceiling with a total window perimeter of 50 feet, a crack 1/16th inch around each window and a 15-mile wind striking the window. There will be 7,300 cubic feet of outside air enter the room per hour around the windows. That is to say 3.75 room volumes of air must be heated from zero to 70 degrees every hour at an expenditure of 9,280 B.t.u. With soft coal at $10 per ton (average price used by Fuel Administration) and 12,000 B.t.u. per lb., burned at 60 per cent efficiency, there will be an expenditure of 15.5 cents per zero day of 24 hours solely for heating the window in-leakage in this one room. Some of this expenditure should be charged up as loss, because no matter how hard builders exert themselves to make a well insulated job there will still be some in-leakage. It is also desirable that a certain amount of outside air enter the houses to insure healthful room conditions. Ventilation, however, may be accomplished in a better way, by the opening of windows or through specially prepared ventilating ducts.

Most data on fuel cost of windows fails to take account of the old-fashioned storm sash—a very useful asset to every owner. The transmission loss through glass is high, and it can be cut in two by the use of storm sash as the two thicknesses of glass (with atmosphere between) reduces the rate of loss full 50 per cent. Figuring the window area of a home, the reduced heat loss and consequent reduction of fuel soon pays for the cost of the storm sash over and over again, while the added heatability insures safety against cold floors for the children and the dangerous "forcing" of furnace fires. Half the winter fires in homes are caused by overheated chimneys, pipes and plants, because of forced fires, a fact which gives storm sash a new value as protection of lives and property as well as the fuel dollars.

Builders, including "home merchants" who build to sell, have learned the importance not only of weatherstrips but of the proper installation of weatherstrips so that windows will not stick and so that the job may be tight. Recent innovations in the designs of windows have included types which have special design to shut out cold winds. Some of these have semi-weather strip features as well as the convenience in washing the glass; others provide a leverage to force the sash tightly into place. Builders do well who consider what the fuel costs will be of the windows not only when installed but five years later. As frame sash are sure to shrink, some provision must be made to tighten them; since the years increase the air leakage unless they are well weatherstripped. The five-year-cost factor of well weatherstripped building has importance far beyond the comprehension of most people, especially when shown in dollars and tons for ten years and longer periods. On that basis the home buyer could afford to pay almost double—although he would not have to—for a home with tight windows equipped with storm sash. In comparison to the house in which the windows rattle at every gust of wind and in which the doors shrink away from the sill a half inch or more on sides of a building exposed to winter winds, such a home is far more easily paid for.

Moreover there is a saving in the reduced amount of radiation needed to heat a tight home, a saving which goes far to cover the cost of the weatherstripping. This saving will be from $15 to $25 for each window weatherstripped if $2 per square foot installed be taken as the basis of cost of radiation.

The annual saving in fuel is one which any builder can use to advantage in reselling an investment made to insure tight windows. "Figure it out yourself," said a heating engineer, "with the loose windows each costing needlessly some 400 lbs. of anthracite coal each year—a total of 4 tons wasted for the house. This represents close to $80 in one year and in 10 years almost $800, repaying over and over again in money spent for prevention of air leakage in addition to which there is comfort, satisfaction and safety. In many cases the saving amounts to 20 to 40 per cent. Is that worth while?

As no city building department can spare a minute from the problems of structural strength and fire safety to give home builders any help on heatability, it has become the particular hobby of many contractors to see that the houses they erect and finish can make a good showing in the matter of fuel cost and comfort. The subject has become a pressing one among realtors who have found they can sell buildings with "comfort built in" at a profit in money as well as satisfaction. The National Association of Real Estate Boards endorsed the proposal that houses be "certified" as to materials and workmanship.

Modern Building Methods Are the Arch Enemy of the Rat

THE rat, most wasteful of all animals and more destructive of human life than all wars, has resisted successfully all efforts to control it. It has matched every man-made agency for its destruction with added cunning and with a rapidity of reproduction that has enabled it more than to hold its own down through the centuries. And no reduction in the number of rats has followed the great impetus given to rat destruction by the knowledge that these pests are directly responsible for the perpetuation of that most dread human disease, bubonic plague.

Screened Basement Windows Are a Necessary Part of Rat-Proofing Any Building. Every means of entrance must be closed.

Many intelligent men have devoted their lives to a study of methods of rat control, and countless preparations, devices and contrivances are constantly being made available. Trapping, snaring, trailing, flooding, digging, hunting, ferreting, poisoning and fumigating, and rat limes, rat lures, rat repellents, bacterial viruses and even anti-rat laws, local, state and national, are constantly being employed in a world-wide effort to get the best of this rodent.

These have been a factor in keeping the rat population within bounds, that is, in keeping down the surplus, but all destructive agencies that have ever been used have utterly failed noticeably to reduce what might be called the standing rat population of the world. The total number of rats in the world today is probably as great as it ever has been, and undoubtedly the economic loss caused by their depredations is greater at the present time than in any similar period in the world's history.

Unfinished Work Such as This Is Responsible for the Invasion of Rats in Many Modern Buildings Which Are Otherwise Rat-Proof.

If all this be true, and economic mammalogists are practically agreed that it is, then the situation is indeed serious. But it is in reality not quite so black as painted, for there is a new agency at work which, although in many cases innocent of any design or intent upon the rat, gives promise of menacing its very existence. In progressive regions of the United States at least it has in large measure made apparent a material reduction in the rat population. This new agency is modern methods of building construction.

Modern construction, even without regard to the rat, is opposed to everything that makes for the best interests of the rat. It calls for the liberal use of indestructible and noncombustible materials, and well-made cement and steel are too much for even the sharpest of rodent incisors. It calls for fire-stopping in double walls and floors, and for elimination of all dead spaces and dark corners. The rat is left no place in which to hide. It embodies sanitary features that provide for hygienic storage of food, and the rat cannot live without something to feed upon.

The rat is dependent primarily upon two things, food and shelter. Its food must be ample and its shelter must afford protection and uninterrupted opportunity for rearing its young, in order that it may maintain its high prolificacy. Such food and shelter were always abundantly available in the buildings of yesterday, and that is why we have the rat with us in such abundance today. Only a small percentage of rats may be found away from the protection of man and his handiwork.

In spite of all of his reputed wisdom man has been less a menace to the rat than the natural enemies which it might encounter in the open. But modern construction is changing this order of things; it is depriving the rat of man-made protection and is forcing it into the open where in the life struggle it will be at a fatal disadvantage.

Modern construction is bringing this about, and to the modern builder goes much of the credit for this desirable

condition. That anti-rat considerations did not motivate the modern builder in his use of concrete, and the more pointed truth that most builders are not even aware of the part they are playing in the control of the world's greatest pest, do not lessen the fact that today the modern builder is the greatest enemy of the rat.

If modern construction without regard to rodents has proved so effective in shutting out rats, how much more effective would be construction designed specifically to exclude them. That a modern building is absolutely rat-proof, or is not, is often only the result of chance, thoughtlessness, or carelessness. A small hole may be left in an unobtrusive corner where pipes enter the wall, or a ventilator or sewer opening may lack the proper grating, or a basement window may be left unscreened. Such minor oversights may lead to years of rat trouble for occupants of a building who have not sufficient ingenuity to locate the source of their troubles.

In other cases, double-wall construction may cause endless rat troubles that might have been avoided at small cost had the rodent problem been considered in drawing the plans. Even in the most thoroughly rat-proofed buildings rats will occasionally gain entrance through open doors or with supplies that are brought in. If any safe retreat is available, as double walls opening beneath the first floor and in the attic, the beginning is made of an infestation that is hard to dislodge.

Blocking the open spaces between studs and floor joists with bricks, cinders and cement, or other noncombustible material not only would prove a barrier to rats but also would afford protection in case of fire by stopping the drafts and rise of heated gases and also would provide better insulation against heat and cold.

Some buildings, such as those not having full basements or continuous retaining walls, present other problems, but no form of rat-proof construction has proved inconsistent with the best type of construction, nor has it been found to cost in excess of its worth.

About thirty towns and cities have regulations requiring firestops in walls, and many others are known to favor.

Rat-proofing measures should not end with fire stopping, however, but should require, under rigid inspection, that all new structures be so planned and built that rats and mice will not be able to gain ready entrance nor find shelter should they accidentally do so. At least thirteen towns or cities have now passed rat-proofing ordinances, most of which have to do with rat-proofing buildings, and many others are contemplating similar action.

Such regulations would not be so urgently needed if architects and builders would realize the great service they could perform by building the rat out of every new structure, and by so doing build out of the country and possibly out of existence the most vicious and persistent enemy of mankind.

An Example of What May Be Accomplished by Overcoating an Old Building. It is reported that the new stucco overcoating increased the actual sales value of this house $2,000.

Better Plastering

REAMS and reams have been written about the need for more permanent construction. Singularly most of these dissertations have emphasized the desirability of permanent exteriors, and those that require a minimum of upkeep. Very little has been said of the urgent need of a permanent interior finish for the house, and yet in many buildings much more thought must be given to the upkeep of the interior, after the first two or three years, than for the outer walls of the building.

Four thousand years ago, the plasterer ranked with the sculptor and artist in the pride which he took in the artistry and permanence of his work. As a matter of fact, much of our knowledge of the history and customs of the ancients is revealed by records wrought into the work of these ancient craftsmen.

Plastering should be an art today just as it was in those bygone days, but only occasionally do we find plaster surfaces rivaling the permanence and beauty of those of centuries ago. Our craftsmen of today are just as capable, although their art is expressed in simple effects that are none the less attractive, than the masterpieces of the 15th century. As a matter of fact, modern methods have simplified their work and permanence is achieved in days, instead of weeks and months with our present-day materials which were unknown in earlier times.

Since Eighty Per Cent of the Visible Interior of the Average House Is Plastered Surface, Plastering Is an All Important Factor in Establishing Permanent Beauty.

Consider further that 80 per cent of the visible interior of the average home is represented by the plastered surfaces. They are always before the eye of the home owner and the visitor. They are the background for the decorations and furnishings, and inasmuch as the character of the completed interior is recognized as an index of the characteristics of the occupants of the home, the housewife takes keenest interest in the appearance of the interior. Is it not strange, then, that more thought has not been given heretofore toward informing builders and the building public on methods of securing plaster walls which will maintain their original beauty and thus afford permanence to the background of the interior.

Nor is the subject as simple as at first blush it might seem to be. Many factors enter into the problem of better plastering, and it will be the purpose of this chapter to discuss their relationship, how to avoid the pitfalls of poor plastering and how to secure permanent, crack-proof and fire resistive plastered surfaces.

In the first place, plastering is subjected to vibration, temperature changes, moisture and stresses. As one walks through the home, vibrations are transmitted to the ceilings below and to the walls. When doors and windows slam, the plastering is jarred. During a high wind the whole house is subjected to vibration.

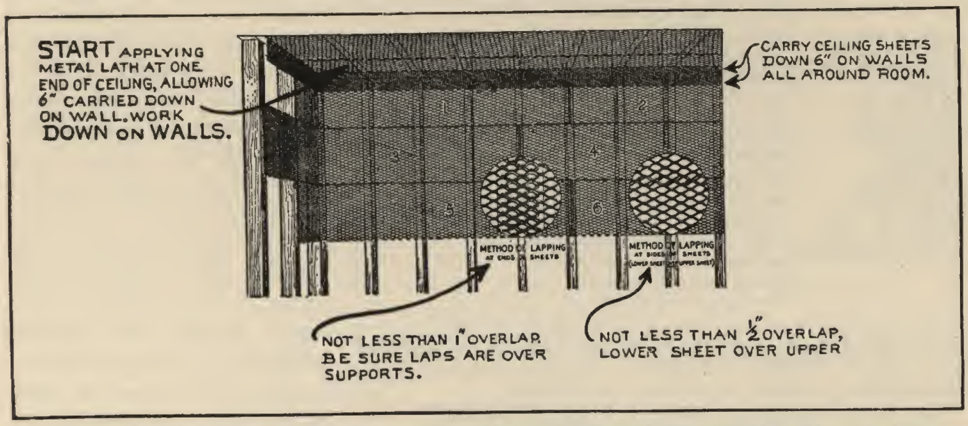
Variations in temperature subject plastering to extremes which test its endurance as does no other single element. When the temperature in the house changes from daytime's comfortable warmth to the chill of a winter night the plastering tends to shrink, and as the heat comes on in the morning, the plastering tends to expand. Similar variations during the heat of the summer, although not perhaps of such large magnitude as in wintry weather, also constitute a severe test of plaster and clearly show that a strong base is needed to reinforce the plaster against such disruptive action.

Consider next the question of moisture. In two rooms in the house, the kitchen and bathroom, moisture is more prevalent than on other parts of the home. All plaster is more or less absorptive and the moisture is conducted through the plaster into the base. If this is of an absorptive nature also, it will have a tendency to swell or warp, and subsequently to shrink. Because of the low tensile strength of the plaster, endurance is severely taxed both in the swelling and drying out processes.

Shrinkage is a factor which again comes into play when the partly seasoned lumber dries out, as artificial heat is supplied during the heating season. There are ways of counteracting the influence of shrinkage which puts a severe strain on the plastering, and these will be discussed farther on in this book.

Wind stresses have a tendency to rack buildings, especially those having a wood structural frame. If the building is not properly constructed and braced, wood studs and joists will sway and give, and here again stresses are conveyed to the plaster which, if not reinforced, will crack. The stability which we admire in older buildings is due to the plentiful use of substantial and permanent materials. The Romans and Egyptians built thick, solid, masonry walls. Later, as material was conserved, the walls were made thinner and then the hollow wall came into use. In this country with our virgin forests of unmeasurable vastness, masonry walls, because of their relative greater cost, were, in the early days, largely supplanted by walls of heavy timber. Now, however, the timber supply is measurable; the forests in the Eastern and Central states have almost vanished. Those of the Southern states are showing results of the vast inroads of the construction industry and our greatest source of timber is now in the far Western country. This, for the

average home, means large freight rates and a relatively large increase in the cost of lumber delivered to the building site. It also means, instead of hand cut timbers, the lighter lumber must be used more sparingly. Our average houses



There Is One Best Way of Applying Metal Lath and This Order Should Always Be Followed with Careful Attention to the Correct Lapping of All Joints and Wiring to Prevent Bulging and Stiffen the Surface.

today are not as heavily built or as substantial as those of years ago. Where in the early days the plastering was merely the surface finish applied on the interior surface of rugged timber walls, it is today frequently called upon to reinforce the entire building on account of the light lumber which goes into this structural frame.

Another movement which has come to play an important part in the field of building construction is the demand for fire prevention. Every year $88,000,000 worth of residence construction is destroyed by fire and over 15,000 lives are lost. Every hour, day and night, 25 residences catch fire.

These many factors of vibration, temperature changes, moisture, wind and loading stresses and fire prevention all play an important part in the discussion of the subject of better plastering. In this chapter we will endeavor to present in an interesting way many facts which have hitherto been lost sight of, that the builder and home buying public will have information on this necessary element of home construction which comprises 80 per cent of the visible interior.

Applying the Plastering Base

Plaster can be no more permanent than the base upon which it is applied.

Possibly this has been said before, but even if so, it is worthy of repetition, for there is nothing upon which the continued interior beauty of the finished home is more dependent. This material, hidden away as it is in a new home, under successive coats of plaster comes in for little thought on the part of the owner.

If the owner of the new home is fortunate in having a good and conscientious builder, he will be able to forget the fact that there is such a material as lath in his home. Unfortunately this too often proves to be one of those things, which "might have been."

For about the time the family gets nicely settled in the new home the new home is likely to do a little settling itself. And it is then that the caliber of the builder and the materials he used come in for a test.

Often a deficiency in the lath makes itself known first by a series of cracks which appear in the walls. Possibly this is not the fault of the plaster base, but the fault of the framing of the home. But at any rate the cracks are there and must be patched.

Unfortunately this patching of plaster is only part of the problem and expense involved. Whatever decorations have been chosen for the walls must be done over again, and even so there is no definite assurance that more cracks will not appear after the patching and redecorating are completed.

Another condition which is all too common is the appearance of "lath shadows" upon the ceilings and walls of rooms. In these cases, which all of us have seen, the lath seems to take substance and show through the plaster and whatever decorations there may be, like the ribs show through the hide of a starved, flea-bitten horse.

These lath shadows, so often blamed on the dust settling through the plaster, because they usually appear more pronounced in the ceiling of the room, are really caused by dust which has been caught in the condensation of moisture in the more poorly insulated portions of the wall or ceiling.

Look carefully at the next case of this kind which you see. You will notice that the darker portions are directly opposite the joints between the lath, while the wider portions over the lath are more nearly original color of the finish.

Dust gathers most where there is the greatest difference between the temperature of the room and the temperature of the space above the room. This is in the space where the plaster keys through the wood lath, affording a ready avenue for the conduction of heat. The wood lath is relatively a poorer conductor than the plaster, so under the space backed by the lath the condensation is less.

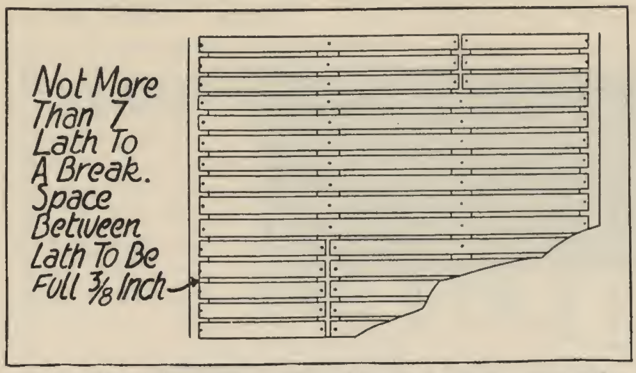
Consequently, when the moisture in the air is condensed in tiny, dust catching globules, it is concentrated on the strips opposite the space between the lath. Here is collected the dust from sweeping, the soot and coal dust and ashes from the basement and the dirt blow in through open windows. Bit by bit the minute particles gather until the pronounced streaking becomes apparent, until redecoration again is necessary.

You will find upon investigation that even on wood lath the only work which is discolored is likely to be only two coat plaster. It is possible in most cases that the trouble would have been lessened by placing another coat of plaster on the walls at the time the house was built. In a ceiling or wall erected on a base of metal lath, the whole surface is made into what is virtually a single slab, with equal heat conductivity in all directions and this trouble is not encountered.

If you are still skeptical as to this being the cause of plaster discolorations, investigate and find the trouble comes most often in the outside walls of kitchens and bathrooms, because the prevalence of moisture and large temperature difference between the indoor and outdoor air. The same condition prevails in upper rooms, on the ceilings which are more exposed to large differences in temperature than in the rooms on the floors below.

There are many bases for plaster now on the market, but probably the two most commonly known are wood lath and metal, with plaster board finding some advocates. The wood lath has been with American builders for many years, but hardly in its present form. There was a time when only the best of white pine was used for lath, hand split and free from defects. This is no longer true, and the person who uses this material should be exceedingly careful to see that the lath are of the proper quality.

The fact is that some of the poorer quality of lumber now used, by force of circumstances on account of the scarcity of better grades, for certain kinds of wood lath contain natural acids which are injurious to plaster and great care should be exercised to select only such lath as is free from destructive elements. The manner in which the lath are applied and the size of nails used are not the least important.



It Is Most Important That Wood Lath Be Carefully Selected and Properly Applied. If this is done much unsatisfactory plaster work can be avoided.

Concerning this material, the specifications recommended by the Contracting Plasterers' International Association says:

"All wood lath to be No. 1 grade lath, 1½ inches wide. Nails to be 3 penny fine, 6 gauge wire nails." And the following additional supplementary suggestions are offered.

"In the Southwestern states yellow pine lath are to be used; in the Pacific Coast region pine and fir lath are used; in the eastern states pine and cypress lath are used. In the Central West mixed lath composed of hard pine and hemlock are used."

This same authority states, as to the manner in which the wood lath is to be applied:

"All wood lath shall be nailed to each stud, joist or bearing, with joints broken, not over seven lath to a break, no vertical or diagonal lathing allowed, a full ⅜-inch key to be left for lime and mortar and not less than ¼ inch for hard plaster."

The jerry builder will slap his lath on so as to leave practically no space for keys. This saves plaster for him, but that does not mean that his price will be any less to the owner. When the lath is wet the wood expands, pinching off the keys and cracking the plaster. That is why the men who devised the above specifications are insistent that the width left for the key of the plaster both at sides and ends of lath is important.

Plaster board comes in sheets of different sizes, varying in thickness from ¼ to ⅜ inch or more. It is usual to specify 1¼ inches, 11½ gauge, 7/16-inch head wire nails for nailing set not more than 4 inches apart, each nail to be driven firm and tight. The board is nailed first in the middle then on the edges.

It is important that the board be placed not less than ¼ inch apart at all horizontal or other joints which do not come on studs or joists. All vertical or other joints coming on joists or studs are butted tight.

Each nailing edge of the board must have a bearing on studs and bases of not less than ¾ inch.

The placing of the board to allow the ¼ inch key for the plaster in the horizontal joints or wherever possible is most essential, since this is the only opportunity given for keying the plaster to the base, the rest of the surface depending entirely on adhesion to bind the plaster to the base.

The joints must be broken at right angles with the wall studs and at right angles with the ceiling joists. Perpendicular joints on opposite sides of a partition must not be on the same stud.

It also should be noted that satisfactory results will not be obtained unless the plaster is at least ½ inch thick. The grounds should be ⅞ inch.

The increasing use of metal lath in construction of all types has brought many inquiries for details of the best method of applying this material. The intelligent use of metal lath demands that the right weight be chosen for the positions in which it is to be used. For walls the metal lath should weigh not less than 2.2 pounds per square yard, but a heavier weight is stiffer and many believe is a real economy for the ceiling to use not less than 3 pounds. For stucco work on exteriors different weights are required, which will be discussed later.

Metal lath comes in bundles of about one dozen sheets. Each bundle will cover from 16 to 27 square yards depending on the style of the lath. This information should come from the material dealers. All of the sheets are approximately 96 inches long and will span eight studs or joists 1 foot on center, or 6 joists or studs, 16 inches on center. The width varies from 16 to 27 inches.

The material can be cut easily with ordinary lather's shears. It should be attached to the wood studs or joists by not less than 6 penny nails driven to a penetration of not less than ⅞ inch, and bent over to engage two strands of the lath. In place of nails, ¾ inch No. 14 wire staples may be used.

Nails or staples should be spaced 6 inches on center and should be placed so that one occurs where upper and lower edges of sheets lap at supports. If a rib lath is used, the nails or staples should hold the ribs on the walls and the nails should be bent upward. Nailing or stapling should start at the center of the sheet and work outward, to make the sheet lie flat and to conserve plaster.

The lathing should be started on the ceiling of the room, bending the ceiling sheet down 6 inches on the side walls.

If the floor above is not of wood joists, lathing should be started at the top of the wall and worked downward. The lath should be bent into vertical corners by carrying around 6 inches on to masonry walls, or if the adjoining wall is of wood studs, start sheet there, one stud away from the corner. The material may be treated roughly with a lather's hatchet to tuck it into the corners. No butt joint should be permitted in any corner.

It is essential in applying metal lath to be sure that the top side is up. The strands of diamond lath are tilted slightly. Care should be taken so that the strand is tilted down and away from the worker. This provides miniature shelves on which the plaster is given support and assists the plasterer greatly in getting a good job.

In starting the metal lath at the top of the room and working down, lap the lower sheet over the upper not less than ½ inch in the case of flat lath. Where rib lath are used, merely to the next rib. This manner of lapping the lower sheet over the upper prevents catching the trowel when the plasterer works his trowel upward. The ends of the sheet should be lapped only over supports and the lap should be not less than 1 inch. Adjacent sheets of lath should be wired together once between supports to prevent bulging and to stiffen the surface under the trowel.

Gypsum Plasters and Their Application on Various Types of Bases

Throughout the ages, many types of plastering materials have been used, but at the present lime and gypsum plasters are the ones in almost universal use, with Keene's cement plaster utilized for interior purposes and portland cement plaster for special uses, which will be considered later. In this chapter we will deal with gypsum plasters, reserving the other types for future discussion.

In general, gypsum plasters are divided into the neat plaster, that is the material as it comes from the mill, the wood fibred plaster, ready sanded plaster and special finish plasters. The first named is the material ordinarily used, where a dependable grade of sand is available. The ready sanded gypsum needs only the addition of water and mixing to the proper consistency to be applied to the plaster base. This material is used to advantage where the local supply of sand is not of a proper nature, but of course the added cost of the freight should be considered.

Wood fibred gypsum, which product contains, intimately mixed, a suitable amount of non-staining wood fibre made by the grinding or shredding of wood, also contains no sand and is intended to be used without the addition of sand when it is applied. This type of plaster is highly regarded by builders and architects as having exceptional endurance and fire resistance.

The gypsum finishing plasters, for trowel and sand float finishes, are chosen with the shade of the finish desired in mind, also for the proper working qualities and for strength and hardness. These prepared plasters need only the addition of water and the proper mixing to be ready for application.

The following grounds are usually specified for the types of bases most often encountered: Metal lath, three-quarter inch; wood lath, three-quarter inch; gypsum plaster board, one-quarter inch thick, three-quarter inch grounds; gypsum plaster board, three-eighths inch, seven-eighths inch ground; gypsum tile, one-half inch grounds, brick and clay tile, five-eighths inch grounds. In usual practice, the grounds are of a thickness which includes the thickness of the lath, but not the thickness of any furring or the rib, in the case of ribbed metal lath.

The makers of gypsum plaster advocate the following mixtures for the neat product for the first or scratch coat:

For wood lath: To one part of the plaster (fibred) add not more than two parts by weight of dry sand.

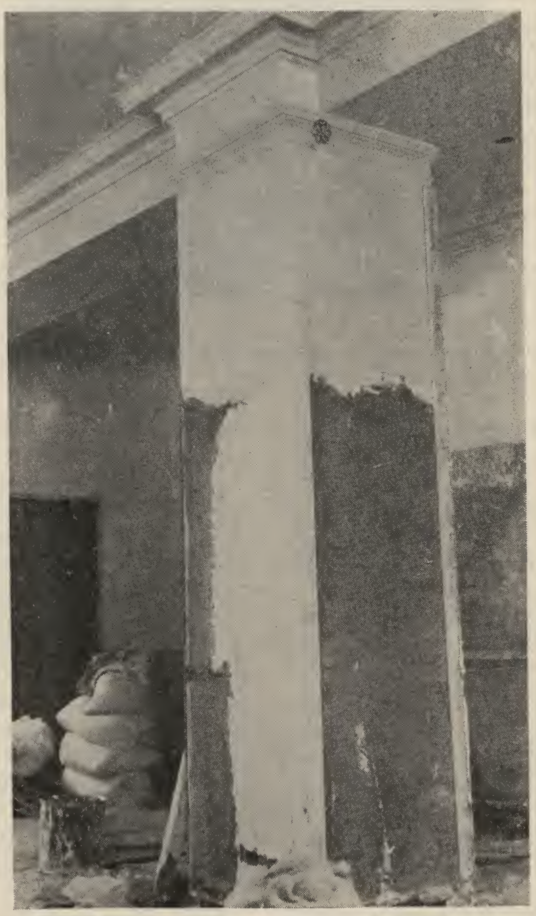
Metal lath: To one part of the plaster (fibred or double fibred) add not more than two parts by weight of dry sand.

Gypsum plaster board: To one part of the plaster (fibred or unfibred) add not more than two parts by weight of dry sand.

Brick, gypsum and clay tile: To one part of the plaster (unfibred) add not more than three parts by weight of dry sand.

For the second or browning coat, on all bases, it is recommended by some authorities that to one part of the unfibred plaster be added two parts of sand. Others state that the best work is insured by using the fibred material in the browning coat as well as the scratch coat.

In the mixing of the neat gypsum, one end of the mortar box is raised about four inches. In the upper end of the box are placed a layer of sand and a layer of plaster. The materials are hoed dry from the upper end of the box to the lower end and back again, until the dry mixture is an even color. Water is placed in the lower end of the box and the sand and plaster hoed into the water, mixing the batch thoroughly to the proper consistency for application. No more material should be mixed than will be used in an hour as the mortar cannot be retempered after it has started to set.



A Plaster Column with Three-Coat Gypsum Plaster Finished Above and the Brown Coat Gypsum Plaster, to Be Finished with Keene's Cement, Below.

A note of warning concerning the condition of wood lath when this base is used is proper here. It is considered the best practice to sprinkle wood lath thoroughly twenty-four hours before the plastering is applied and again dampen them about an hour before the plastering starts. The lath should be damp, but there should not be surface water on them or any water collected along the bottom of the lath in drops or globules. The idea is to have the lath expand before the plaster is applied.

While the method of applying two coat work to wood lath and on gypsum plaster board is given here, it is not the best grade of work, and its use cannot be recommended where the best construction is wanted. According to the advice of the National Council for Better Plastering, which is conducting a campaign to raise plastering standards, the reputation of plasterers and builders in general is suffering through the use of work of this inferior type in plastering.

But if two-coat work is to be used on wood lath, the first coat should be applied with sufficient force to fill all of the spaces between the lath and to obtain a firm and full key.

It should be straightened back from the grounds to allow for the finishing coat. The surface of the base coat should be broomed or roughened to receive the finishing coat. When thoroughly set and nearly dry, the finishing coat may be applied. This finishing coat and that for the other operations to be given here will be considered later.

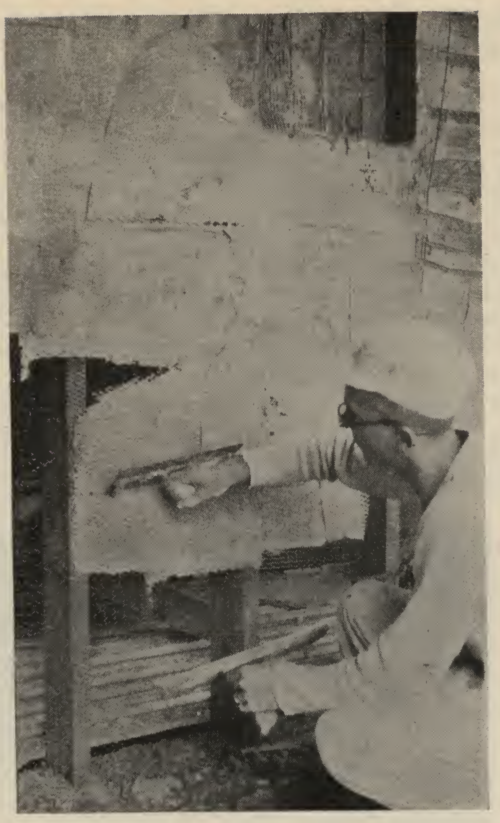
For three-coat work on wood lath, the process with the first or scratch coat is the same as on two-coat work, care being taken to scratch this coat to provide a good bond for the second or browning coat. This is applied when the first coat has set good and hard but before it is dry. This coat is straightened and kept back from the grounds to allow for the finishing

coat. The surface of this coat is roughened or broomed for the finishing coat which is applied when the second coat is nearly dry.

On metal lath, where three-coat work is used, the first coat is applied with sufficient pressure to fill in all the meshes, so that it covers and stiffens the fabric. Because of the nature of the material, a full key and very satisfactory bond for the plaster always results. This key is insurance to the owner that plaster will not fall off ceilings and in other places where the plaster is subjected to vibration.

In applying the scratch coat on metal lath, the trowel should not scrape the lath and the plaster should extend at least a quarter of an inch beyond the face of the lath. It is then scratched to insure a bond for the second or browning coat, which is applied and prepared for the finishing coat in the manner described for wood lath.

Two- and three-coat work on plaster board is done in the manner indicated for similar work on wood lath, care being taken to work the first coat well into all spaces between the boards. The plaster board should not be dampened before plastering.



In Order to Make a First Class Job of Plastering the Studding Must Be Absolutely Upright.

On brick, gypsum and clay tile, when necessary to kill excessive suction, the surface is wet before the plastering is done. A thin coat of plaster is applied, then doubling back over the area covered, the second or browning coat is applied and straightened for the finishing coat. This second coat is broomed and when thoroughly set and nearly dry, the finishing coat is applied.

The directions given before apply equally to the wood fibred gypsum plaster and to ready-sanded gypsum plaster with the exception of the mixing.

With the wood-fibred plaster, the gypsum material is placed in the raised end of the box, the water in the lower, and the plaster hoed into the water, where it should be allowed to soak for a few minutes. After mixing to a proper consistency, it is ready for application. With the ready-sanded gypsum the material is placed in one end of the box, the water in the other, and when mixed to the proper consistency is ready for application.

Gypsum finishing plasters, used for the finishing coat, are prepared materials which require only the addition of water and proper mixing to make them ready for application.

It is usual to place the plaster in the upper end of the mortar box, the water in the lower, using approximately one part of water to two parts of plaster, by volume. The plaster is allowed to soak in the water, without hoeing, for at least ten minutes. After all the material has soaked and there are no further signs of bubbles, it should be mixed thoroughly and with particular care to break the mortar down to a smooth, even consistency. When properly mixed it is too thin to carry in a hod but can be handled in a bucket.

The base coat should be set and practically dry before this finish is applied. If the suction is too great, the surface of the wall should be sprinkled slightly with clear water, using a clean brush.

The plaster trowel finish is applied in three operations. First, a coat as thin as possible is applied, pressing it firmly into the base coat and covering the surface completely. A second coat is doubled back over the first, leveled out and allowed to draw. The surface is then troweled even, filling in the imperfections. This is allowed to draw for a few moments and is again troweled smooth. The top and bottom of the wall should be worked at the same time to avoid joinings.

For sand float finishes, the material is laid on with a trowel and then a cork, carpet or felt float is used, the cork float being considered the best. The float is used to work the finish to a true surface, free from float marks or other imperfections. It is advisable to use as little water as possible while floating; the finish cannot be floated after it has begun to set.

Gypsum finishing plaster, often termed gauging gypsum plaster, often is used with lime for a finishing coat. It is used in the proportions of one part of the gypsum material to two parts of thoroughly slacked quick lime or hydrated lime putty. This is equal to about one part of the gypsum finish to two parts of dry hydrated lime, by weight.

These materials are mixed by making a ring of thoroughly hydrated lime putty on the mixing board, putting clean water in the center of the ring and sifting the gypsum powder into the water, allowing it to soak for a few moments. This is mixed to a uniform consistency, then the lime putty is cut and all mixed to a uniform paste consistency. It is applied as is the trowel finish before described.

Certain general precautions should be observed in working with gypsum plasters. Nearly half of the water used in mixing the plasters is necessary to the chemical change which takes place when the plaster hardens. This process is interfered with if the plaster dries out before the set takes place. All plaster should be protected against uneven or too rapid drying. In cold, damp or rainy weather it is necessary to see that artificial means for drying are provided. Precautions should be taken, however, against drying the plaster out too rapidly or in spots. Plaster must not freeze. After it has set and become hard, free air circulation should be provided.

Some of the more common difficulties encountered in plastering, with possible remedies, are worthy of consideration.

Plaster which sets too slowly may be speeded up by using a prepared accelerator, which is made by almost every manufacturer of plaster. When this material cannot be had the required result may be accomplished by scraping the sides of the mixing box and using the material scraped off in the plaster mixture. Another method of speeding up the setting of the wall is to soak and set up plaster in a barrel for several hours and use the water for mixing. Another method used when the foregoing fail is to mix from four to six pounds of alum or zinc sulphate in a barrel of water. From

two to twelve quarts of this solution are mixed in the amount of water used for each bag of plaster. Slow setting is usually caused by impurities in the water used or in the sand.

Plaster which sets too quickly usually is the result of a dirty mortar box or tools, or to the use of plaster which has been wet or exposed to dampness. It may be remedied by using a prepared retarder or through the use of the following formula:

Dissolve one pound of pulverized glue in one gallon of hot water; mix about one pint of this into the mixing water for each bag of plaster.

Lime Plasters, Their Preparation and Application

Lime is one of the most ancient of the known building materials and has a very interesting history. Indeed, its use is so old that evidently it was known long before recorded history. Evidences of the use of mortar are found, not only in the older countries of Europe, Asia and Africa, but also on the Western Hemisphere, where the remains of works of ancient artisans show its use. These ruins prove the enduring qualities of the material as well as the skill of the workmen.

One writer considering the possible discovery of lime declares it possible that some savages, having used stones composed of lime rock to confine their fire, noticed that the stones were changed by the action of the heat. He believes it possible that a passing shower slacked the lime to a paste and the discovery was made that the paste was smooth, easily worked and made a better material for filling up the cracks and crevices in the crude dwellings of the savages than did the clay they had been using.

The ancient pyramids of Egypt reveal one of the earliest uses of mortar. Vicat in his work on "Mortars and Concrete" states:

"The Egyptian monuments present without a doubt the most ancient and remarkable examples which we can cite of the use of lime in building. The mortar which binds the blocks of the pyramids, and more particularly those of the Cheops, is exactly similar to our mortars in Europe. That which we find between the joints of the decayed buildings at Ombos, at Edfou, and in the Island of Phila, and on other places give evidence by its color, of a reddish, very fine sand mixed with lime in the ordinary proportions."

Lime mortar used for binding bricks and other masonry units differs from the lime used for interior plastering only slightly, the main difference being in the plasticity of the mortar. Some of the finest interiors of ancient Rome and the interiors of religious structures, where the height of Renaissance construction was reached, were of plaster which endures to the present day.

Plaster, to give that satisfactory and durable service which has proved it to be the most pleasing and utilitarian interior finish yet known, should be three coat work on a proper and permanent base.

This applies with equal strength to lime as to the other plastering materials in common use. It is worthy of repeating and remembering that no matter how high grade the materials and how careful the workmanship, only three-coat work on a permanent base will produce the best wall.

Lime for plaster now is most generally used in two forms: quick-lime which requires slacking, careful preparation and aging on the job, and hydrated lime. Ready mixed lime mortar is also now available in some cities from central mixing plants and is delivered on the job ready to be applied to the walls.

Lime, used in plastering, is a chemical combination of calcium and oxygen. Lump lime, or quick lime, is made by taking limestone, chemically known as calcium carbonate, and burning it in a kiln. The limestone crumbles and disintegrates, loosing a gas in the process that leaves the product of the kiln in the form of an oxide of calcium or quick lime. However, in this state it is very susceptible to the influence of moisture and air and has a tendency to resume its original form, so it must be protected against moisture and contact with the air.

For lime plastering, the plasterer begins with this product of the kiln—quick-lime—and takes it through a series of operations by which it reverses the decomposing or breaking down process ending at the kiln, so that on the wall the setting element of the plaster proceeds to resume, as nearly as it can, its original state, namely limestone.

The first operation is quite simple and is called "slacking," which is done merely by adding water to the quick-lime. From this slacking process is produced lime putty which is the basis of all lime plasters. (The use of hydrated lime in producing lime putty will be described later.)

Lime putty produced from quicklime must be of the correct stiffness and must be free from lumps which are lime that has not been disintegrated and thoroughly combined with the water. An additional precaution must be taken in that this putty must be aged so that the chemical processes are completed before it is used on the walls. This aging varies with different limes and must be learned by experience with the lime used.

Ordinarily in slacking lime, enough water is added to produce a thick paste after the reaction of slacking is completed. Sufficient water should be used in order that it may come into contact with all parts of the lime. If too little water is used some parts of the mass become dry and are "burned" in the process. "Burned" lime works tough and non-plastic in the mortar. If an excess of water is used slacking is retarded and the paste is thin and watery. This is known as "drowned" paste.

A quick slacking lime requires a large amount of water and this must be added quickly and the lime must be turned over rapidly so that the water may get to all parts and there will be no "burning" from the temperatures generated by the chemical reaction. Slower slacking lime requires less water and in their use, care must be exercised to avoid "drowned paste."

The amount of water to be used in slacking varies with the lime. The quick slacking limes, known as high calcium limes, usually take from 28 to 32 gallons of water to a barrel of lime, while the slower slacking limes, known as dolomithic limes, average about 24 gallons to a barrel. These figures, however, can be only accepted as approximate.

The necessity for allowing time for aging after slacking is due largely to the fact that all limes contain some over-burned particles or some which have combined chemically with silica or clay in the limestone. These particles slack very slowly.

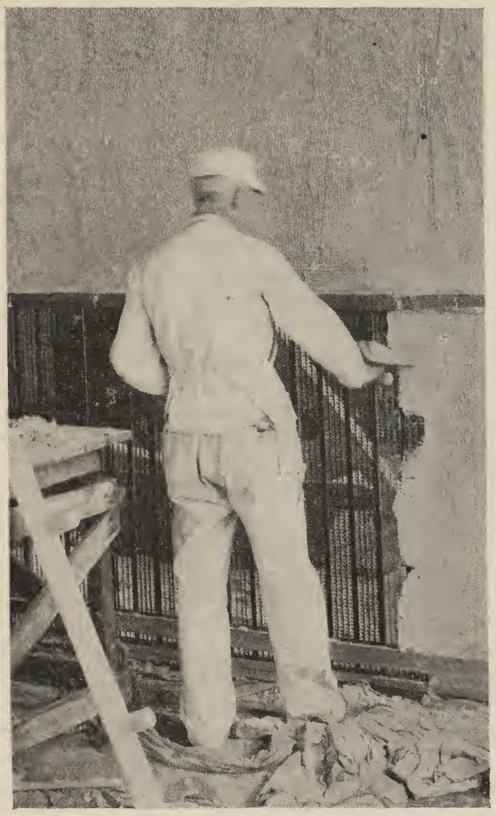
A rule which comes from the ancient Romans will be interesting and possibly instructive to the workman. Vitruvis says: "......take a hoe and apply it to the slacked lime as you would hew wood. If it sticks to the hoe in bits, the lime is not yet tempered, and when the hoe is drawn out dry and clean, it will show that the lime is weak and thirsty, but when it is rich and properly slacked, it will stick to the tool like glue, proving that it is completely tempered."

Hydrated lime differs from quick-lime in that it has sufficient water added to satisfy the calcium oxide. This product arrives on the job in the shape of powder and from it lime putty is made by adding sufficient water so that standing over night it will produce a stiff paste. No heat is generated in this process and therefore there is no danger of burning. Also there is no danger of lumps or unslacked

lime in the putty. From this point the treatment of the lime putty is the same for both products.

There now remains to be considered the manner in which this lime putty is to be mixed for application to the walls of different types. In the Standard Specifications for Lime Plaster, from which the following information is taken, it is specified that:

"The mortar shall be a mixture of lime, paste or putty, prepared from properly slacked quick-lime which has been



The First, or Scratch, Coat of the Plaster Should Be Applied Firmly, to Insure a Good Key with the Lath.

allowed to age, either neat or sanded for at least three days, or hydrated lime with sand" in the proportions given for each type of wall.

In giving the proportions for the various types of work, those for the brown and scratch coats will be given now while the various types of finishing coats, which may be applied to any of the base coats, will be treated later.

For two-coat work on wood lath known as double-up work, since the brown coat is applied immediately after the scratch coat, grounds of five-eighths inch are specified. For the scratch coat is mixed: stiff lime putty one part by volume, plastering sand two parts by volume, hair or fibre one and one-half bushels per cubic yard of sand. The brown coat is composed of one part of stiff lime putty by volume to three parts of plastering sand.

The first coat of mortar is applied with sufficient pressure to insure a good key at the back of the lath then the plaster is brought out to grounds by doubling on this coat. The rod and darby are used to bring a true even surface for the finishing coat. It should be observed in passing that two-coat work is never recommended on wood lath except on cheap construction as with five-eighths inch grounds the plaster covers the lath only one-fourth inch. Where economy is desirable, two-coat work on certain types of ribbed metal lath is preferable as the plaster covers the lath to a greater depth and this reduces the tendency toward plaster cracks.

For three-coat work on metal lath, the first coat is of the same proportions as for two-coat work on wood lath, except that the hair or fibre is added in the proportion of one bushel per cubic yard of sand. The brown coat is the same as for the two-coat work on wood lath except that here one-half bushel of hair or fibre is used to each cubic yard of sand. The grounds for this work are seven-eighths inch.

The scratch coat is applied one-quarter of an inch thick, care being taken to insure a good key at the back of the lath. As soon as this coat has become firm, but not fully dry or hard, the entire surface should be scratched diagonally, deep enough to provide a good bond for the following coat but not deep enough to injure the keys. The second coat is applied when this coat is dried, and used to bring the plaster out to the grounds. This coat should be well worked and the surface, although brought to a true even plane for the finish should be left sufficiently rough to insure a good bond with the last coat, which is applied when the brown coat is dry. The same specifications are given for three-coat work on wood lath, excepting that less hair or fibre is needed in the scratch coat, and more in the brown coat.

Sometimes, it is found advisable to use gauged lime plaster. This is especially true of three-coat work on metal lath where the lath is furred out on metal furring. In such cases, it is preferred that the lime, putty, sand and hair be mixed thoroughly by machine if possible. When hydrated lime is used, the materials may be mixed by hand if desired. Just before the order is delivered to the plasterer, the proper amount of gauging should be added and well worked in. No more plaster should be gauged at one time than can be applied within one and one-half hours after it is added. The proportions for the scratch coat for this material are as follows:

The stiff lime putty eighty per cent, gauging cement twenty per cent, one part by volume, plastering sand two parts by volume, hair or fibre one bushel per cubic yard of sand. For the brown coat the stiff lime putty is ninety per cent and the gauging cement ten per cent. This should comprise one part by volume of the mixture, plastering sand three parts by volume and hair or fibre to be added at the ratio of one-half bushel per cubic yard of sand.

The plaster should be applied to seven-eighths inch grounds. The first coat should be applied one-quarter inch thick with sufficient moisture to make a good key. As soon as this coat has become firm, but not fully dry, the surface should be scratched as described previously for three-coat work. When the first coat is hard, the second coat is applied. This is applied to bring the surface out to the ground. It is important that this coat should be well worked. When the second coat is dry, it is ready for the finish coat. For two-coat, doubled-up work on brick, tile, gypsum block and like surfaces, the proportions are: stiff lime putty one part by volume and plastering sand two and one-half parts by volume for the brown coat. For the brown coat, the stiff lime putty is used in the proportion of one part by volume to four parts by volume of plastering sand. This plastering is done to five-eighths inch grounds. The mortar joints of the walls to be plastered should be cut flush and the surfaces should be cleaned and be free from oil, grease, or soot. All masonry surfaces should be well wet before plastering but there should not be a film of free water present when the plasterers begin.

One-quarter inch coat of mortar is applied with sufficient force to secure a good bond to the masonry and then the plaster is brought out to grounds by doubling up on this coat with the brown coat. Rod, darby and float are used to bring a true even finish for the finished coat.

The same proportions for the ground and brown coat are used in two-coat plaster work on concrete. The plastering

is to the same grounds, five-eighths inch. All concrete surfaces to be plastered should be cast in rough boards so as to provide a good bond for the plaster. If the concrete surface is smooth or glazed, it should be hacked or roughed so as to provide a sufficient mechanical bond, or ten per cent by volume of portland cement should be added to the bond coat mix. Just before plastering, the surface should be wire brushed and scrubbed clean in order to be free from oil, grease, or soot. The concrete should be practically dry but if bone dry should be moistened with a brush shortly before plastering starts.

No mortar should be applied to wet or frozen concrete. The brown coat is applied one-quarter inch thick. Before this coat has hardened it should be deeply double scratched. When the brown coat is hard but not dry, the plaster is brought out to grounds with the brown mortar coat. When this coat is dry, the finish is applied.

Finishing coats are usually of four kinds, hard white coat, the white sand finish, the brown sand finish, and the white skim coat. In all cases where quick-lime is used for finishing it should be thoroughly slacked in a water-tight box and should be run through a No. 10 sieve (10 meshes per inch), and allowed to cool before being applied. Where hydrated lime is used, it should be made into a putty and allowed to stand over night before using.

For the hard white coat, stiff lime putty three parts by volume is mixed with plaster of paris, one part by volume. The white coat is applied evenly and troweled to a hard smooth finish. This finish should be true to plane and free from all brush marks and other imperfections.

The white sand finish is composed of stiff lime putty three parts by volume, white sand three parts by volume, and plaster of paris one part by volume. This sand finish coat should be applied in a thin, even coat and troweled or worked, or rubbed to the desired even finish and texture. For the brown sand finish, stiff lime putty, one part by volume. To this is added plaster of paris or portland cement as required, usually about twenty per cent.

It is important to know that the proportions of sand given above cannot be accepted as absolutely correct. The quality of the sand has a large bearing upon this matter and only experience with the sand can guide the plasterer accurately in this matter.

Special features and problems in plastering will now be taken up.

Stucco Homes Prove Their Worth Where Good Materials and Good Workmanship Are Combined

Stucco homes are by no means a modern development, since some of the earliest habitations of man were structures of this type, where a framework was covered with a plastic material, often on a base of woven twigs. Early in the history of the human race plastic materials were developed which had the permanence requisite to make such stucco habitations practicable. Many examples of such construction still exist, with a history of thousands of years behind them in Egypt, Greece, and other ancient lands.

In the United States we now find stucco homes, after a rather unfortunate period, again becoming one of the predominating forms of construction. The unfortunate time for homes of this type was when they fell into the hands of unscrupulous, and sometimes uninformed, builders. These homes, skimped in materials and erected by inefficient and uninformed workmen, failed to give the satisfaction to which their eventual owners believed they were entitled. Too often they were erected for the immediate profit they offered, and this in a period when the so-called speculative builders gained

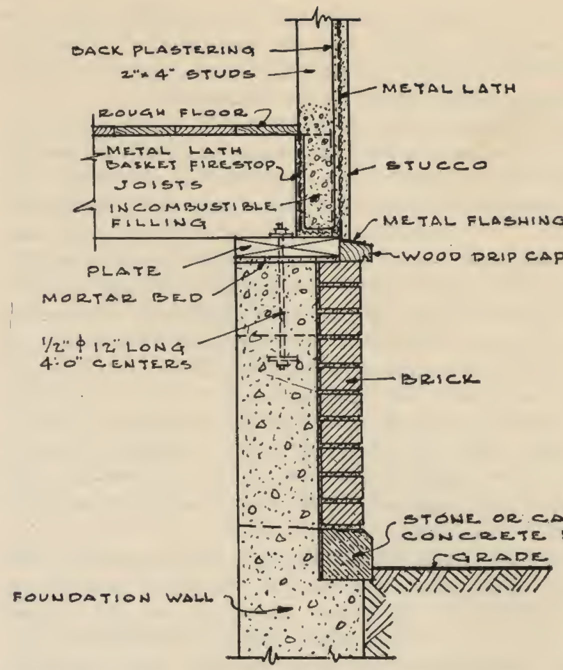


Fig. 1. Sill Construction, Balloon Frame, Joists Resting on Wood Sills.

the dubious reputation which is now rapidly being cleared up by operators of the better class.

Now, persons who contemplate building have learned that stucco construction, like every other form of building, must be well done, and when so done is very satisfactory. It has been learned that it is no easier to hide defects under a coat of stucco than it is under coats of paint.

The popularity of stucco is manifest by the predominance of this type of construction on the Pacific coast, where the number of homes so built exceeds that of any other type. This is not so surprising as is the fact that in such cities as Minneapolis, stucco homes fast are gaining the lead over other types of houses. And this in a climate as trying to building materials as any in the United States.

The reasons for the success of stucco in these two spots, which are typical examples, are quite similar and have a common origin—good workmanship. In California the handling of this finish has engaged the interest of craftsmen of the highest type, and through much experience, the builders refuse to tolerate inferior workmen or materials. In Minneapolis, a rigid building code limits the materials to those approved and three plastering inspectors keep the workmanship up to a high standard.

In building good stucco structures, the responsibility, as is the case in plastering, starts before the plasterers get on the job. This is so well recognized in California that the best of the stucco workers refuse to take jobs where the structural elements of the building will not measure up to the requirements of good workmanship. They know that nothing but dissatisfaction can result and refuse to shoulder the blame for faults which they know are bound to appear.

There are today a number of bases used for stucco. Among the more familiar ones are stone, concrete, concrete block or tile, hollow clay building tile, and in another division, lath of metal or wood especially prepared for a stucco base. This latter class is applied over a framework of wood and will be dealt with in this chapter, other bases being left for future discussion.

In buildings of this type, the foundation is of primary importance. With the now general use of concrete and concrete blocks, good foundations have become universally demanded for all types of construction, even where natural

stone is not readily available. But in building the stucco home, while the rigidity and the load bearing qualities of the foundation are of utmost importance, there is another requirement which must not be overlooked.

The foundation must be at least 12 inches above the ground. This is to guard against placing the framework of the building so close to the ground that the stucco will absorb moisture through capillary attraction to its eventful detriment. It is important to remember at all times in stucco construction that if the stucco surfaces are so designed that they will shed water instead of retaining it and that capillary action is prevented, no amount of moisture will be injurious.

Fig. 1 shows a commonly used system of basement wall construction where there is no objection to the basement windows showing. The masonry walls run up to the level of the under side of the joists which lie directly on them or on wooden sills laid on the masonry. Basement windows in such a plan must have the rough frame cast in place when the wall is poured and the brick veneer should be supported on an angle iron lintel.

In this, as in all other foundation details, anchor bolts or beam filling have been specified to insure a good job. The house must be more than casually set on the foundation, it must be fastened. This has been demonstrated repeatedly in tornado and earthquake disasters, where the advisability of making the entire structure a unit was proven. For solid or timber sills, bolts ½ inch in diameter and 12 inches long, 4 feet on center, should be cast in place in the concrete or imbedded in the brick, concrete block or tile, with enough of the bolt projecting so that the timber can be bolted quickly to the masonry. Before bolting the sill down a layer of mortar should be spread on the masonry so that the joint between it and the sill will be sealed effectively.

A box sill type of construction, such as is shown in Fig. 2, does not conveniently permit the use of bolts and in this instance the space between the wooden parts is filled to the underside of the joists with cement, known in this use, as beam filling. One inch boards are cut in between the joists to complete the box on the joist bearing walls.

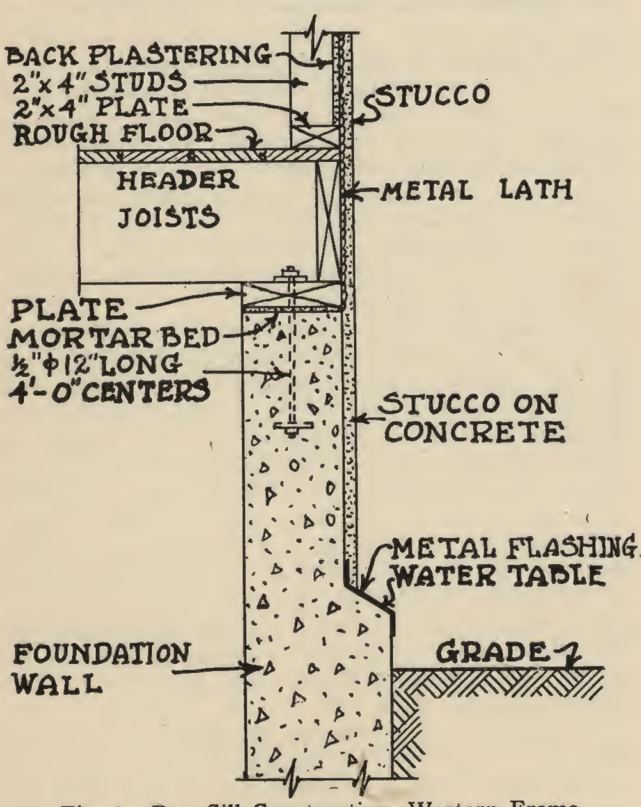


Fig. 2. Box Sill Construction, Western Frame.

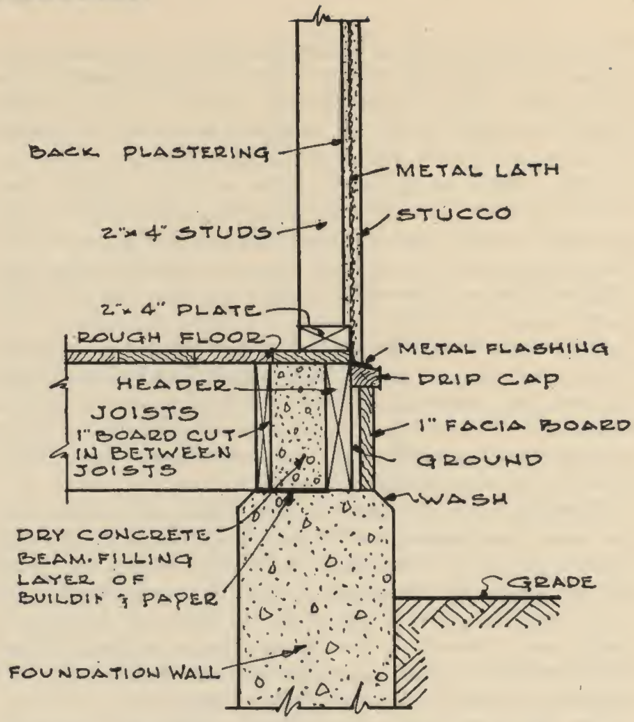


Fig. 3. Box Sill Construction, Joists Resting on Masonry.

On the end walls two inch planks are used for both the inner and outer sides of the box.

The concrete used for beam filling should be mixed with only a little water. This insures an early set and eliminates the possibility of rotting the planks, which may occur if a "sloppy" mix is used. Besides making a more rigid base for the structure above, the beam filling seals the joint between the frame work and the foundation, keeping out moisture and cold.

Fig. 3 shows a way of building a wall so that it presents a uniform appearance, down almost to the ground. In this construction, stucco can be run down to the line of the water table, which should be at least one foot above grade. In this case, the portion of the foundation which is above grade for joist bearing is set back to be flush with the lath above. The stucco is then applied at the same time on the foundation and the lath above. Because of the variation in thickness in this foundation, it is easier to build it of poured concrete than of masonry units, although it is feasible to use 10 inch concrete blocks for the lower portion and eight inch blocks for that above.

This drawing also illustrates the box sill combination typical of western frame construction which has two excellent features. The first is the equalizing of the shrinkage in the interior partitions which permits the building to settle uniformly as the lumber dries out. This prevents plaster cracks and does not open unsightly cracks at the baseboard and quarter-round and cause the doors and windows to bind. Secondly, there is the header to which all joists are nailed, which, in conjunction with the rough flooring, which runs out to the edge of the joists, serves as an admirable floor stop.

True Colonial and English types of houses hide their basement windows, and, therefore, windows for the basement must be placed, for the greater part, below the ground line and a cement area built around to allow light to enter the basement. The wall details already described may be modified without difficulty to meet this condition. It is important that each area way have a drain connected to the sewer or that other provision be made so that melting snow and rain will not overflow into the basement.

No apology is offered for this amount of detail in dis-

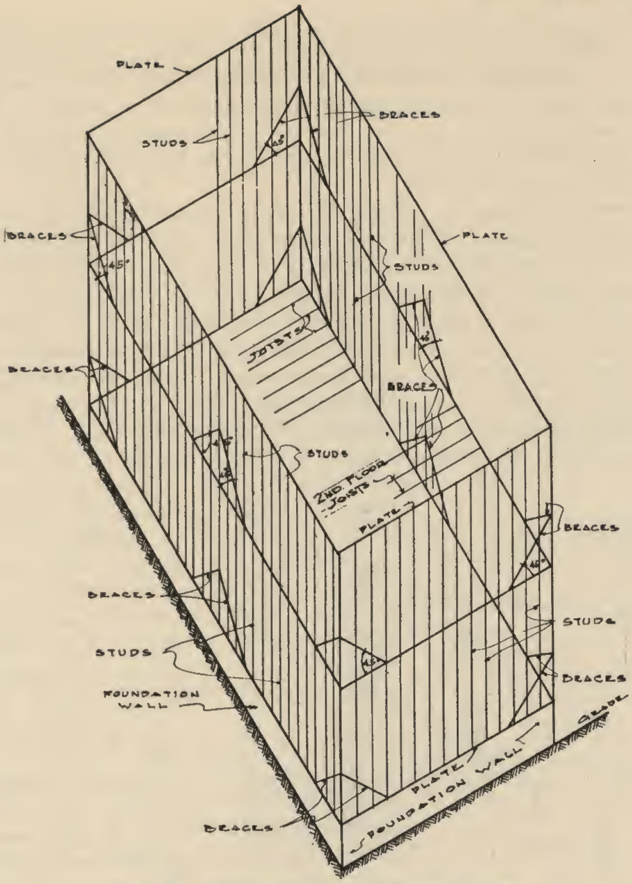


Fig. 4. Diagonal Bracing for Long Buildings.

cussing the basement and foundation walls of the stucco home, since the foundation, as stated earlier, is a vital factor in the durability of the home. Next we will take up correct framing details, flashing, stucco mixtures, and their application and other important points in this construction.

Framing for Stucco Construction Requires Same Careful Consideration Accorded Other Structural Types

With the foundation for the stucco house carefully laid as described in the last article, the attention of the builder now must be turned to the erection of the framework. In stucco homes, as in all others, no matter what the type of covering material used, the framing is of the utmost importance, not only from the standpoint of the stucco, but also to insure long life and satisfaction in the floors, interior finish and woodwork.

By far the greater number of frame buildings are built of two by four-inch studs. This is because they have the minimum economical thickness which is sufficiently strong to support the floor loads common in this form of construction. The spacing of 16 inches on center is used most commonly and is the greatest interval which is permissible in good construction.

On the other hand, where rigidity and permanence of an unusual degree are desired, or where heavy floor loads are to be carried, studding more closely spaced or with larger cross-section or both should be used. However, two by six-inch studs, 16 inches on center, are amply sufficient in most buildings used for schools, warehouses or similar purposes. In some cases it is advisable to space the studs 12 inches on center. Spacing always should be 12 inches or 16 inches on center to accommodate wood or metal lath without waste.

Diagonal bracing in any building acts as the structural element which offers resistance to distortion caused by wind stresses or any other external force which would tend to rack the building and crack the stucco. In this it assists the sheathing, in sheath construction, in bracing the entire structural frame. In the better type of buildings of stucco and sheathed construction, this diagonal bracing should not be omitted.

One by four-inch stuff is considered sufficiently strong for the braces of an ordinary house having two by four-inch studs. These braces are cut into the surface of the studs so that they are left flush with the inner surface of the studs, ready to receive the inner lathing and plastering. A brace wider than 4 inches tends to take more cut out of the studs in strength than is gained by the additional width of the bracing, although in some instances it may be justified.

For larger buildings, where two by six-inch studs are used, the diagonal braces may be one by six inches or even two by four inches. Another method commonly used is two-inch material cut between the studs. For two by four-inch studs the bracing is of the same material except where back plastered construction is to be used, when the material is two by three inches, set flush with the inner surface of the studs so that the back plastering may not be interfered with.

The bracing should be from six to eight feet long, depending upon locations of windows, doors or other openings which may interrupt it, and should be securely nailed with at least two eight-penny nails at each stud which it crosses. Where there are no door or window openings to interfere and an especially good job is wanted, longer braces are advisable and should be used. These may run diagonally from sill to plate, intersecting as many studs as practical.

There should be at least two braces at each corner; one on each of the walls.

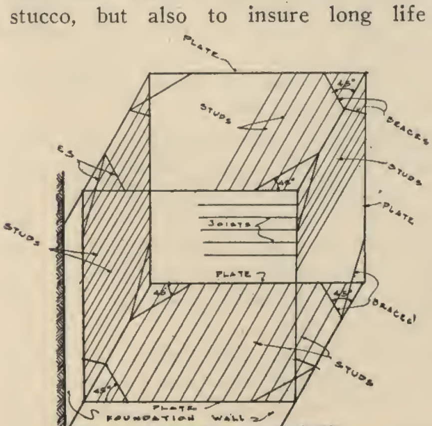


Fig. 5. Diagonal Bracing for One-Story Buildings.

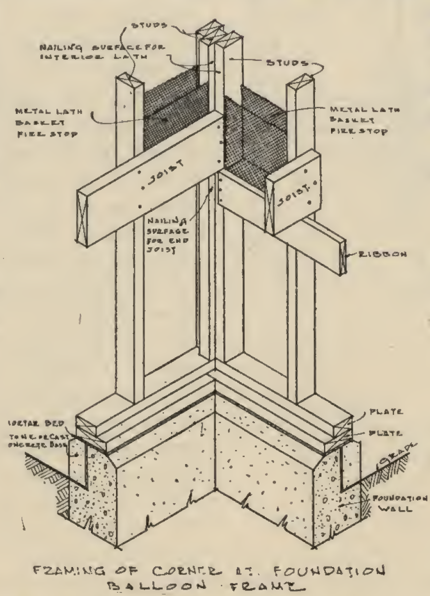


Fig. 6. Framing of Corner at Foundation. Balloon framing.

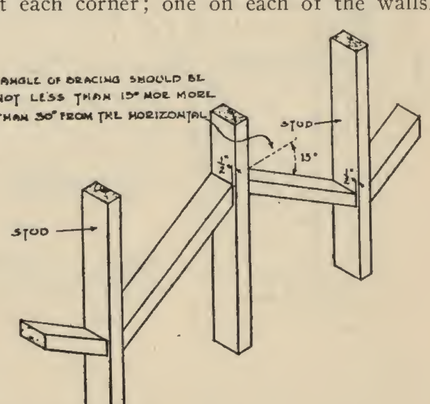


Fig. 7. Diagonal Bracing Placed Between Studs.

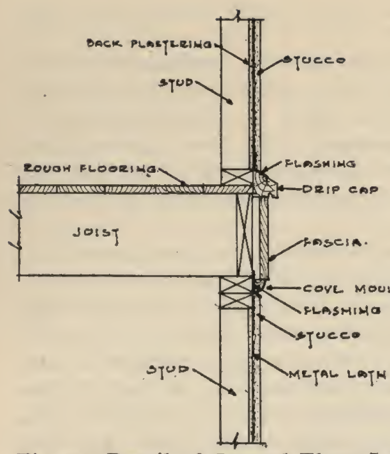


Fig. 8. Detail of Second Floor Level to Forestall Stucco Cracks.

The corner stud and at least three of the next adjoining in each direction should be joined by the brace. The angle of inclination should be not less than thirty degrees from the horizontal and preferably as nearly forty-five degrees as possible. The brace should present a continuous line from the corner stud to the fourth one distant at the line of the sill, joist or plate. For buildings two stories high or higher, bracing as indicated in Fig. 4 will be found satisfactory. For buildings one story high all the braces must be included between the sill and the top plate and bracing as shown in Fig. 5 should be used. Buildings exposed to high wind velocities and those over thirty feet long in any horizontal dimension should be provided with intermediate diagonal bracing as indicated in Fig. 4.

Horizontal bridging is important in the construction of the framework. It should be the same size as the studding and should be set midway of the wall, between the floor and ceiling of the story. This bracing fulfills a variety of necessary uses. It stiffens the studs laterally, assisting the sheathing, it acts as a firestop to confine any fire between the studs to its place of origin and it breaks up the vertical channel between the sill to plate to prevent loss of heat through convection. When placed in a sloping position, as shown in Fig. 7, it

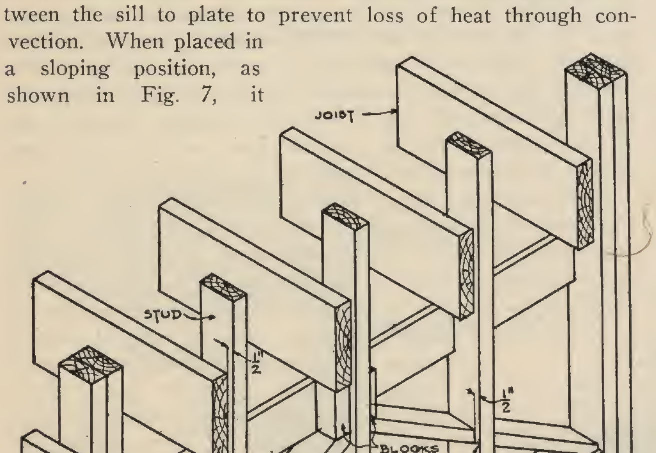


Fig. 9. Framing of Wide Opening.

bridges the load, so that should a settlement of the foundation occur under one stud, the load normally carried by that stud is distributed to the adjacent studs not in the settled area, thus preventing sagging and plaster cracks.

Going into the subject of lateral stiffness, it is natural to expect that a long stick of timber, on end, when loaded will tend to bend or deflect in the direction in which it is weakest—that is, in the direction of its smallest dimension. It, therefore, is most necessary to cut the horizontal bridging in between the studs.

The bridging as shown in Fig. 7 should incline at least fifteen degrees and not more than thirty from the horizontal.

Carrying out the idea of unity throughout the entire structure, especially as concerns resistance to settlement and distortion due to wind action, each end joist should be united with at least two ten-penny nails to each end wall stud. It acts as a girder and stud spacer preventing lateral deflection, thus serving in a capacity somewhat similar as the ribbon or false girt which links together all the bearing studs on the side wall in a balloon frame building. Details of the construction and a recommended method of building up the corner stud are shown in Fig. 6.

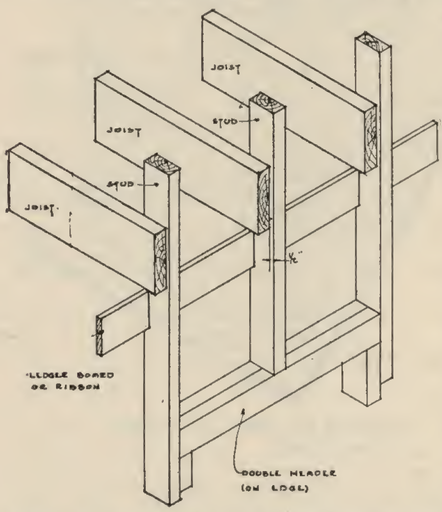


Fig. 10. Framing of Narrow Opening

This figure also shows how built up sills are lapped at the corner to form an acceptable joint. The lower and upper portions of the sill are "run by" alternately and where they lap, one over the other, are nailed securely together.

There is so much horizontal wood subject to shrinkage in the ordinary forms of frame construction that every precaution is to be taken where the balloon type is not used. A way out of the difficulty which suggests itself is omitting the stucco from the portion of the exterior where there is a concentration of wood in compression across the grain. Such a place occurs over the box sill construction at the second floor level. Instead of carrying the stucco continuously over this point, a wood belt course is used, making a cut off between the stucco above and below, as shown in Fig. 8. Flashing should be used liberally at this point, as will be taken up in a later chapter.

Nowhere is skimping of material less justified than around the door and window openings. Not only should the studs at the sides of the openings be doubled, but similarly the headers above and below the openings should be doubled as shown in Fig. 10. The two members above the opening should be placed on edge, side by side, to develop their greatest strength. Below windows, where the header is supported by studs, the members may be laid flat.

Doubling the studs flanking the opening insures the ample lateral stiffness to take care of the greater loads thrust upon this member due to cutting away the studs to make the opening. Alhough it might appear that the load on the flanking studs would be the same as on the other studs, this is not the case. The double header over the opening prevents unsightly sagging which is all too common with the inadequate single header laid flat.

All openings more than four feet wide should be trussed. The reasons for this are similar to those given above. The load must be distributed advantageously to prevent sagging and consequent cracking of the stucco. The correct method of framing around a large opening, in this instance a triple window, is shown in Fig. 9.

"Keep the Water From Behind the Stucco" Is a Fundamental Rule of Proper Stucco Construction

One of the most essential elements in the design of a stucco structure is provision for keeping the water from behind the stucco. This should go even further and the designer should make a study of avoiding any undue concentration of water from getting at the stucco at any point. A study of the methods of avoiding damaging leaks and drips by means of proper flashing will be one well worth the while of the builder.

The reason for this is that capillary action, which draws moisture up into the stucco must be avoided. If stucco is so constructed that it can draw moisture from the ground or any other sources, deterioration cannot be avoided. This is caused for the most part by the alternate expansion and contraction resulting from the recurrent freezing and thawing of the absorbed water, which effects breaks between the stucco and finally causes cracks in the material.

Suitable flashing should be provided over all door and window openings and wherever projecting wood trim occurs. Wall copings, cornices, rails, chimney caps, etc., should be of concrete, stone, terra cotta or metal, with ample overhanging drop grooves or lips and water tight joints. If copings are set in blocks with mortar joints, continuous flashing should extend under the coping, projecting beyond and forming an inconspicuous lip over the upper edge of the stucco. Continuous flashing with a similar projecting lip should be provided under brick sills. This flashing should be so installed as to provide absolute protection against interior leakage.

Cornices should project well from the face of the stucco and should be provided wth drip grooves or flashing. Sills also should be provided with flashing to insure the wash of water over the face and not over the ends.

Special attention should be given to the designs of downspouts and gutters at the returns of porch roofs where the overflow would result in discoloration and cracking. The end joints should be protected with sheet lead or zinc flashings.

The reader will no doubt recall seeing many instances of stucco jobs that have failed at just this point; and on analysis will find that moisture got behind the stucco.

Wherever the design of the structure permits, an overhanging roof or similar projection is recommended for the protection it affords. It cannot be emphasized too strongly that all exposed stucco surfaces should shed water quickly. Whenever departure from the vertical is necessary, as at water tables, belt courses, and the like, the greatest possible slope should be used.

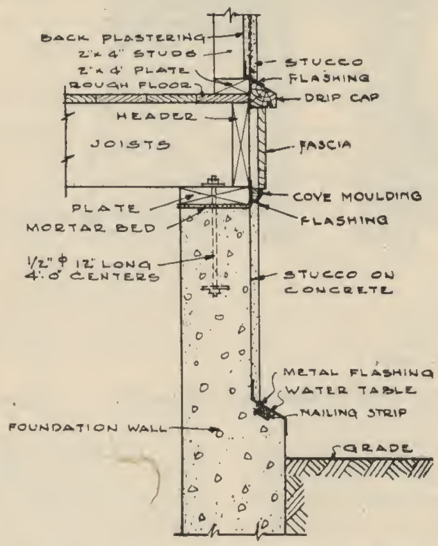


Fig. 11. Box Sill Construction, Western Frame.

It should be remembered that the flashing should be, in almost every case, in position before the metal lath is applied. Exception to this rule will be noted in the details of flashing which will follow the general requirements given above.

Good flashing for a structure must, of necessity, begin with the foundation. In Fig. 11 are shown details of proper flashing where the frame of the home joins the foundation in the box sill type of western frame construction.

It will be noted that in this type of construction that the stucco and metal lath of the framework are separated from the foundation by a fascia board. Above this board is a drip cap of wood. The flashing, which should project at least two inches up the side of the wall, comes from behind the metal lath to project upon this drip cap beyond the face of the finished stucco.

The form of the wooden drip cap is particularly important. It should slope on the top, of course, and equally important is the groove cut in the under side of the cap. Water from the top, turned by the flashing and the slope of the wood, tends to cling to the surface of the wood until it is brought around and again comes into contact with the wall of the building. When it strikes the groove, cut into the under side of the cap, its progress is interrupted, it concentrates and of its own weight falls clear.

It will be noted

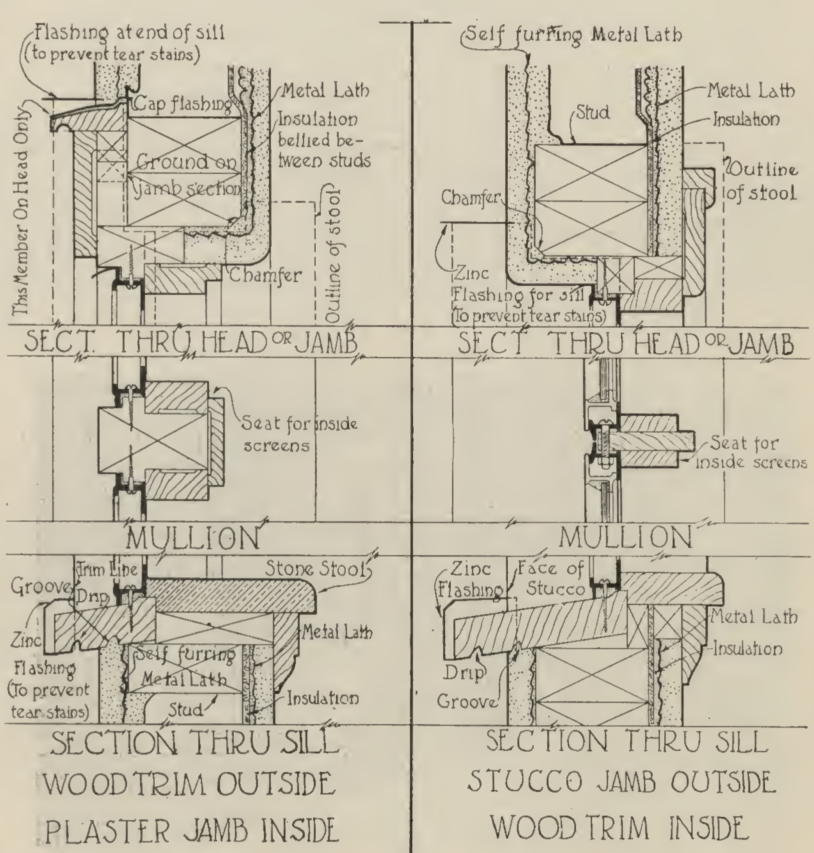


Fig. 12. Flashings in Combination with Steel Casement Windows in Back Plastered Construction.

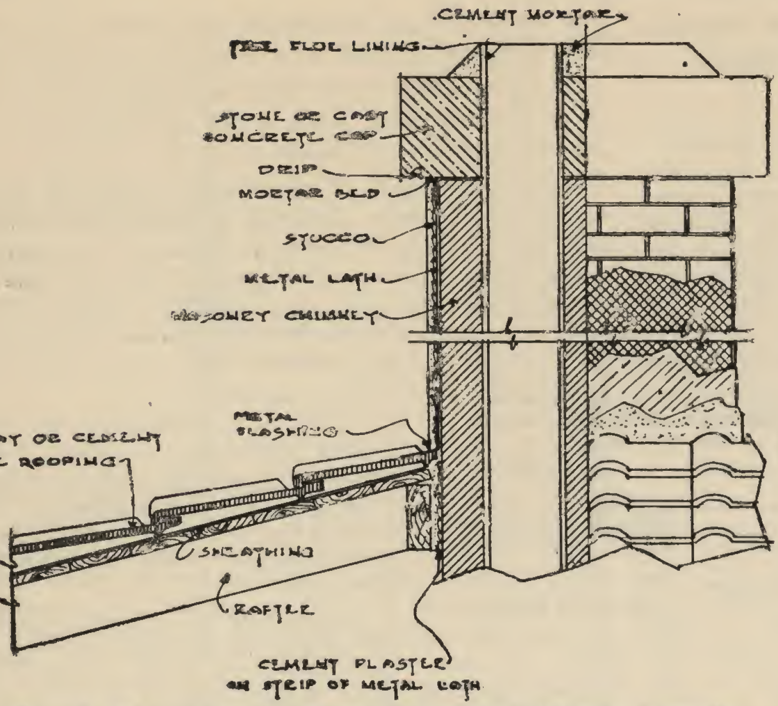


Fig. 13. Metal Lath on a Stucco Base Over a Masonry Chimney.

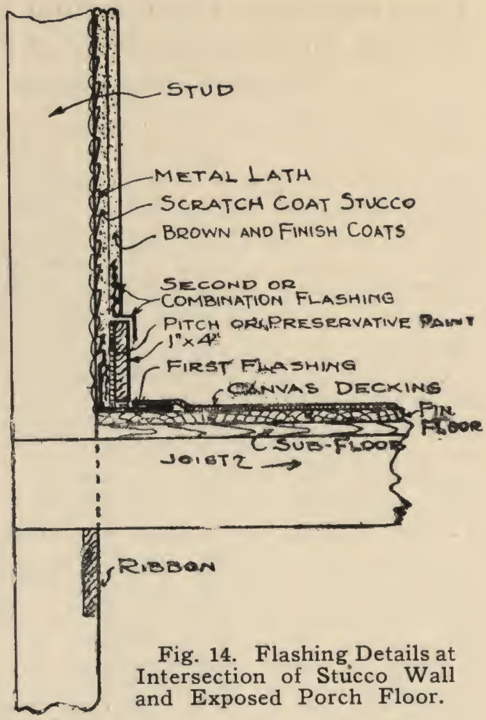


Fig. 14. Flashing Details at Intersection of Stucco Wall and Exposed Porch Floor.

that directly under the fascia board in Fig. 11 there is a cove moulding which is in contact with the foundation. Here again flashing should be used, coming from behind the cove and over the top of the stucco which covers the foundation.

As has been noted before in this discussion, the stucco should not be carried to the ground, where it may absorb water. Here it is stopped at the water table, which is given an adequate slope to carry off any moisture which may fall at this point. Where no fascia board or other wood construction is used between the stucco on the framework of the house and the stucco on the foundation and the vertical surface is not interrupted until the water table is reached, no flashing is used.

The detail shown in Fig. 11 may also be used where a fascia board is run around the entire house between the first and second stories, as sometimes is done in the western type of frame construction to forestall cracks as shown in a previous chapter. The only difference is that the stucco on metal lath resumes under the cove moulding instead of the stucco on the foundation as shown in the illustration.

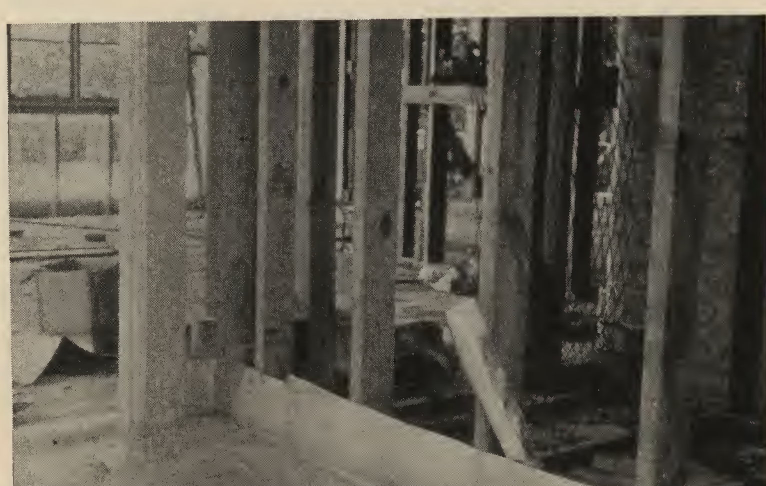
When a brick foundation, or a brick veneer is used on the outside of a foundation wall of other material, the stucco and metal lath may be run down to a wooden drip cap which rests directly on top of the foundation, and which is flashed in the same manner as is shown in Fig. 11.

Another important point is the flashing over the outside of the door and window caps. Here the flashing should be brought from the wall behind the metal lath and project onto the top of the cap wall beyond the point where the finished stucco will come. Usually the mouldings of the window or door frames will eliminate the necessity of caring for the drip which will be lead over the front of the caps. See Fig. 12 for flashing details in combination with steel casement windows in back plastered construction.

In places or parts of buildings where it is difficult and uneconomical to lay up masonry units to act as a stucco base in the case of curved or irregular surfaces, it has been found that a very satisfactory solution to the problem lies in the use of expanded metal or metal lath. These can be applied over wood or steel studs which are so located as to conform with the general contour of the surface desired, or the steel studs can be shaped to conform.

Another method is to use wood cut with a band saw to the desired curvature of irregular outline and secure this to a vertical support and then apply the metal lath over it. Stucco applied on metal lath has been found to perform quite as satisfactorily as stucco over masonry units so that the two types of bases can be used jointly to meet all architectural requirements.

A problem which has puzzled many of the builders of stucco homes is that of avoiding the "tear" stains which sometimes form at the ends of the window sills. These stains, in the form of stripes of discoloration under both ends of a window, are formed by the concentration of water on the window sills washing off the ends of the sill in a stream instead of over the front edge. This concentration of water often wears away the wash coat of the stucco, the coloring, or



Flashing of Flat Decks Is One of the Problems of Careful Stucco Construction. Here is shown the first step.

stains through impurities carried in the water, possibly dirt washed from the window sill.

The solution of the problem obviously lies in eliminating the concentration of water at the ends of the sill and forcing it over the front edge. This is accomplished by nailing small squares of zinc at the extreme ends of the sill. These strips force the water over the front where concentration and consequent damage to the finish of the stucco is avoided.

It should also be remembered that the under side of the sill should be grooved as was the drip cap provided for the joining of the foundation and the walls. This will keep the water from the wall directly under the windows.

A most important place for proper flashings is about the chimneys. On a stucco home the chimneys usually are finished in stucco to harmonize with the rest of the house, but are of masonry construction, lined to conform with the rules of fire safety. The stucco should be applied only after the chimney has been carefully covered with metal lath. Such a chimney always should have a cap of stone, cast concrete or other masonry which will overhang the metal lath and stucco and provide protection against water seeping in at the joint. Usually this is accomplished by providing a generous overhang and grooving the underside of the chimney cap well away from the stucco, so that the water will be carried to the vertical, and unbroken portions of the chimney where it can do no damage.

With such a chimney, as with any other, the flashing between the chimney and the roof is a matter which the builder must watch carefully. Details of such flashing are shown in Fig. 13. The sheet metal is brought from behind the metal lath, well up on the chimney and well under the roofing material. It should be remembered that this must be applied before the chimney is stuccoed or the roof finished.

A problem in flashing frequently met in the construction of houses of the Italian and Spanish types is found when a stucco wall comes to a finish at the floor of a flat exposed deck over a porch, loggia or similar extension from the main structure. Such a roof, with almost imperceptible pitch, affords a lodging place for snow and ice, and flashing of the ordinary nature often will not serve to protect the wall properly when a thaw comes and forces the roof to carry off a large amount of water, which the slight pitch will not allow it to do rapidly.

An excellent manner in which to plan such a detail is shown in Fig 14. The first steps of the construction are shown in the illustration of such a deck before the lath or stucco had been applied to the walls or the finishing material to the top of the deck.

Flashing first is placed in the angle formed by the junction of the deck and the wall. This is given a generous allowance on both surfaces. The metal lath and first coat of stucco then are applied. Following this, a board one inch by four inches, covered on its back and bottom with pitch or a preservative paint, is nailed to the wall through the scratch coat of stucco and into the wood studs, the bottom edge of the board being in contact with the flashing on the deck.

Another flashing then is placed on top of the board, in the manner shown in the diagram, and the two finishing coats of stucco brought down over this last flashing. In this manner the stucco both behind and above the wood board is protected from the water.

Many details may arise in the erection of a house and the manner in which they are handled marks the difference between competent and incompetent design and between the entirely satisfactory home and one which may prove troublesome. Each flashing problem is to some extent individual, but by following the examples given and altering the details to fit the job in hand a satisfactory building will result.

Some Details on the Backing of Better Plaster and Stucco Work

We have reached a point in this chapter on Better Plastering and Better Stucco at which we think it opportune to glance over and develop some of the details which were presented only in their general aspect at the time.

One of the first things discussed was the matter of careful selection and application of wood lath. Only the other day a study was afforded of the plastering on the old Palmer House, built in Chicago shortly after the world famous fire of 1871, and which has been wrecked to make way for a larger and more modern structure. One of the first things noted was the very fine grade of wood lath which was used as a base for plastering.

Measurements of both the lath and keps showed the lath to be quite 7/16 inch thick and that the space between the lath was equal to the full thickness of the individual lath. As a matter of fact, in the old days it was common for the architect's or owner's inspector to go over the building and carefully examine to see whether the lath was in shape for plastering. This he did by taking a lath and seeing whether it would pass between the adjoining lath. If it didn't, it indicated that the key was insufficient and the lath had to be torn down and reapplied correctly.

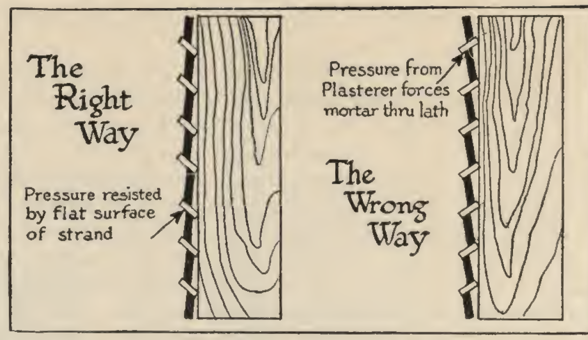


Fig. 16—In Applying Metal Lath It Is Essential to See That the Top Side Is Up, Providing Miniature Shelves on Which the Plaster Is Supported.

The lath used in the old Palmer House was roughly 7/16 inch thick and was rough and free from knots. Compare this with the modern lath which is a little better than 5/16 inch thick and one readily sees that one of the reasons for the failure of much of our interior plastering which is put on a wood base is the fact that the lath is not thick and strong enough to resist twisting and warping. Gone, too, are the boundless forests of white pine from which came the Palmer House straight grain lath. Swamp tamarack, resin pine, and hemlock are the source of much of our wood lath and that is why unusual care must be taken to see that it is free from pitch resin, or acid stains, etc., which, if present, will leach out into the plaster and cause staining, disfiguring and discoloration which are so difficult to remove and cover up.

Probably the factor which had most to do to make old time plastering so satisfactory was the large plaster keys which were used. It insured a good fat plaster key which came out on the back side and held the plaster firmly in place so as to prevent plaster falling off ceilings and from cracking as it now does, at the slightest provocation. Jerry-builders have the tendency to overlook giving their men instructions to space the lath the required distance apart. We have observed numerous instances where perhaps a ⅛-inch key was allowed. Not only is this wholly inadequate but placing the lath so closely permits the plasterers to skim over the lath so the plaster may not fill up the joints even as far as

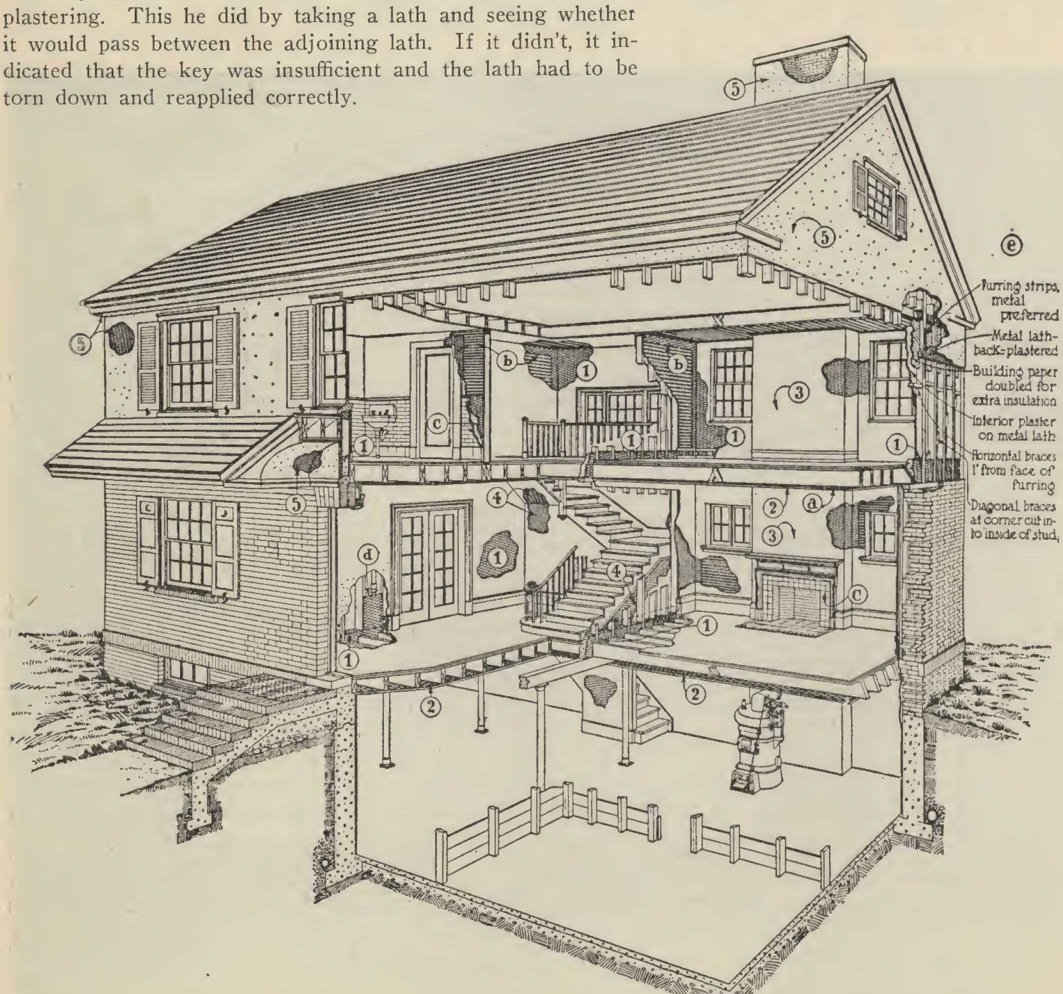


Fig. 15—The Numbers 1 to 5 Indicate Where Better Plastering Should Be Used for Fire Prevention. The letters A to E show where better plastering should be used to prevent plaster cracks.

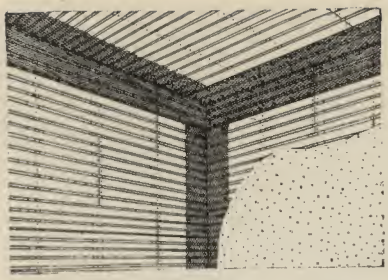


Fig. 17—A 12-Inch Strip of Metal Lath Bent Into the Inside Corners of Walls and Ceilings Reinforces the Plastering Even When Applied Over an Ordinary Base.

the back side of the lath. The result is that the plaster is given only a surface bond to the lath.

An examination of the Palmer House lath showed that it had been applied with the old-fashioned cut nail with at least one nail to each joist or stud crossed; all the more reason why nowadays not less than 3d fine, 6-gauge wire nails should be used and unsparingly to insure that the lath is well secured to supports.

Concerning wood lath, the specifications of the Contracting Plasterers' International Association say in part:

"All wood lath shall be nailed to each stud, joist or bearing with joints broken, not over 7 lath to a break, no vertical or diagonal lathing allowed, a full ⅜-inch key to be left for lime and mortar, not less than ¼ inch for hard plaster."

Plasterboard advocates have developed a very interesting method for overcoming the most common cause of plaster cracks on this type of construction. This kink is as follows:

After the plasterboard is nailed to the wall, studs or ceiling joists, taking care to place them at least ¼ inch apart at all joints which do not come on the studs or joists, a strip of metal lath about 4 inches wide is applied over all joints between the plaster board sheets and is nailed to the studs or joists or clipped over the joints which come between supports. The plaster is then applied in the usual manner and it has been found that by reinforcing the joints in this manner the disfiguring cracks which may come between sections of plasterboard are almost entirely eliminated.

One of the most common uses for plasterboard is in repair work where the walls and ceiling are left intact. In these cases the plasterboard is nailed directly over the plaster and it has been found advisable to put pieces of corner lath consisting of narrow strips of metal lath along the angle between walls and ceiling to avoid cracks in those places.

The increasing popularity of metal lath as a plaster base now finds it used in many of the finest homes throughout the country, as well as in buildings such as apartment houses, hotels, store buildings, banks and wherever building codes require it because of its fire protective value. It suggests that readers will be interested in a further explanation of the right and wrong way of applying metal lath.

Observe the diagram reproduced at top of page 146, Fig. 16. It should be noted that in the process of expanding the lath the strands are tilted slightly. By applying the lath as shown in the left-hand figure the plasterer gains the advantage of having numerous miniature shelves on which the soft plaster can rest while setting. Lath turned upside down has a tendency to permit the plaster to slide off. This makes plastering more difficult, and also wastes plaster as more is forced through than is needed to make a satisfactory key.

Tests made at Armour Institute indicate that where metal lath inside corner pieces were used and applied over wood lath or other plastering bases in corners where partitions abutted, that it reinforced the corners so successfully that if the cracks came at all that they did not occur at the corners, but some distance away. Furthermore, when corners are so reinforced that cracks do not occur with minor shrinkage of the wood which will readily produce disfiguring cracks in unreinforced corners.

The method of applying metal lath for corner protection is shown in the diagram. Manufacturers of this product are now producing metal lath corner strips all ready for application on the job. Undoubtedly one of the least expensive items, they nevertheless are capable of accomplishing much in the way of eliminating annoying and troublesome plaster cracks.

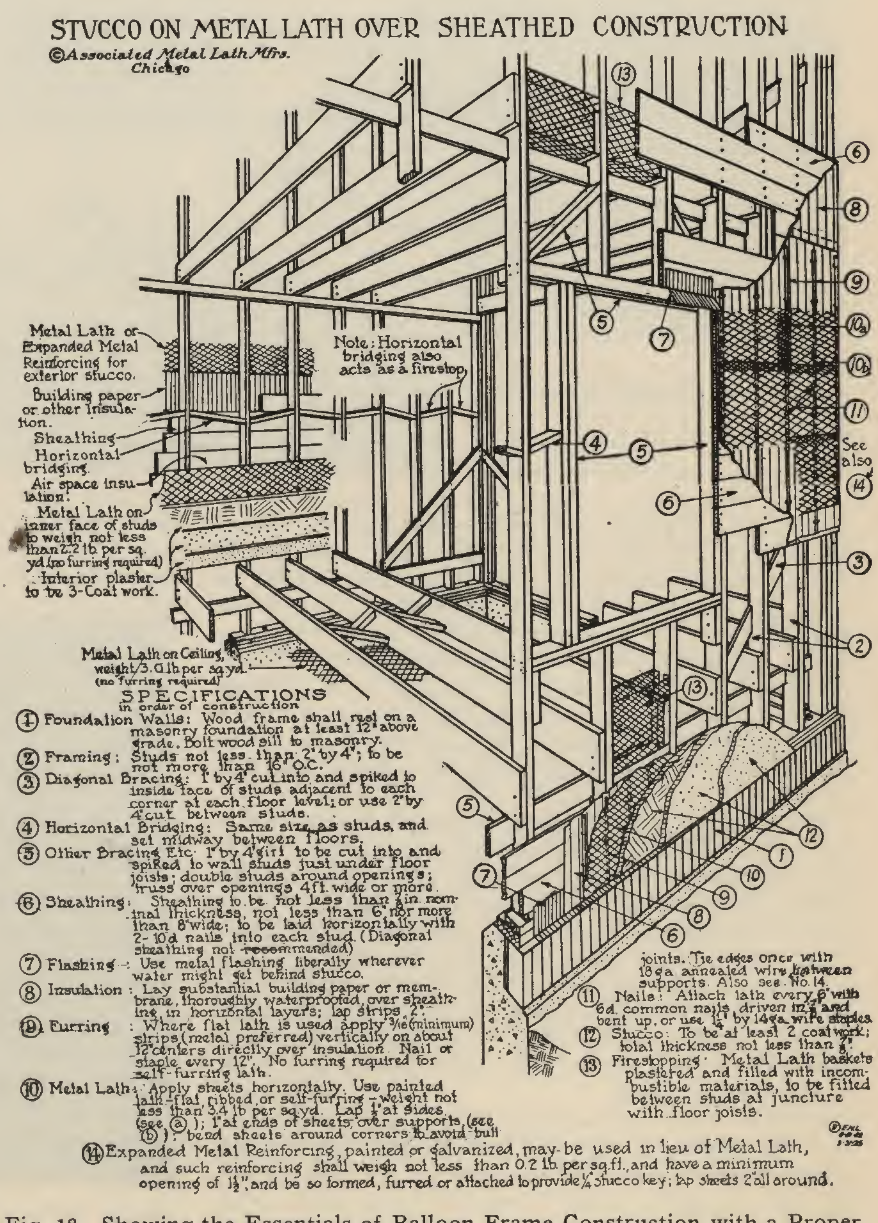


Fig. 18. Showing the Essentials of Balloon Frame Construction with a Proper Base for Stucco.

A Large Sun Room with Vaulted Ceiling, a Type of Construction Where Better Plastering Methods Are Essential to a Satisfactory Piece of Work.

Another of the functions of better plastering is to safeguard homes against fire. Insurance companies now increase the rate of a building where "poor housekeeping" is evidenced by the presence of plaster cracks. Sound, crack-proof plaster has been found to be a very effective fire retardant but when it cracks it offers the fire many avenues for communication to other parts of the building. Investigation has shown that over 90 per cent of all fires are of interior origin and that consequently the interior plastering which forms 80 per cent of the interior surface, performs a very important part in facilitating the confinement of the fire on the one hand, or in permitting its rapid spread on the other.

Some parts of buildings are more susceptible to fire hazards than others. They, at the same time, are those places most difficult of access and where an incipient fire may gain considerable headway before discovery. A national authority on fire prevention has cataloged these as follows.

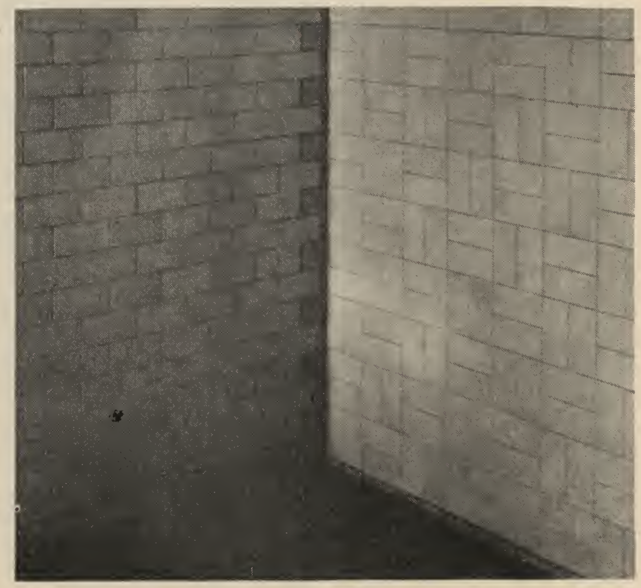
1. Wood stud, bearing partitions and walls, and fire stops between studs and joists.
2. Ceilings under inhabited floors, especially over heating plants.
3. Chimney breasts, around flues and back of kitchen ranges.
4. Stair wells and under stairs.
5. The base and reinforcement for exterior stucco.

These parts of the building therefore should be so protected that, if fire does get a start within, it will be confined to the room of origin, and it has been found by fire tests of engineering laboratories that better plastering applied on metal lath will keep the fire so confined for at least one hour, giving the fire department ample time to reach the scene of the fire before it has had a chance to make substantial headway, and also allowing the occupants of the building sufficient time to make their escape without panic or injury. The diagram shown herewith indicates the places in the building which should be given especial attention from this standpoint.

In the matter of better stucco, which has been treated in its various details in this chapter, it has been found that considerable interest has been aroused in framing details which will show the entire construction. Fig. 18 is an outline diagram which covers the essentials of balloon frame construction, covered with sheathing and on which is applied a metal reinforcing base for the stucco. The various elements in the construction, in the order in which they are erected, are indicated in the diagram and these have been carefully checked with actual practice and found to give excellent results.

It will be noted that the sheathing is applied horizontally. It is the opinion of engineers that sheathing which is applied diagonally tends to set up stresses in the stucco which are apt to crack the finish. Attention is also called to the fact that even with the sheathing it is recommended that the building be diagonally braced at the corner so as to prevent racking caused by wind stresses and also to make the framing self-contained in order that no stresses be communicated to the stucco applied over it.

One of the new wrinkles developed in stucco construction on the Pacific Coast, where stucco has received its greatest impetus and popularity, is the use of large mesh expanded metal reinforcing as a base for the stucco. This reinforcing is applied either with a deformation so as to be self-furring, or is applied over reinforcing strips or by the use of a new type of reinforcing nail or attachment which, while affording a positive method of attachment, also provides a separating feature which keeps the metal the required distance from the backing. The last method of reinforcement insures that the stucco will be pushed all the way back to the waterproof paper and that the reinforcement will be in its proper position in the stucco—that is midway between the surface and the backing. By this means absolute permanence of the stucco is assured.



Metal Lath and Plaster Are Always Needed Under Wall Tiling.

Stucco Overcoating

In countless wooden houses built in every nook and hamlet in the country, many of them in various stages of dilapidation, because of the increased cost of painting so as to make a presentable appearance, the matter of stucco overcoating is of great interest to the contractor and builder. The architect, too, will be interested in knowing just how others have successfully solved the problem covering construction details, and so this article on overcoating will be one of two presented in succeeding issues, to cover both the general principles and actual construction details.

General Principles

Sooner or later many wooden houses come to the end of their period of service. Lack of proper painting and the repair of decayed and rotted timbers supporting porches, and stairs, or the extreme weathering of the trim and siding are the principal causes for deterioration and final ruin. The cost of such upkeep mounts steadily as the building ages; as it reaches its climax the encouragement for maintaining it in good shape dwindles, is finally submerged, and the result is that there are countless old decrepit wooden houses in our cities and on our farms the country over.



Three Stages in the Restoring of a Decaying Frame House, to Beauty and Long Life, by the Application of Good Design and Stucco Over Metal Lath.

Such a house is not beyond repair, however. If the framework is sound and the interior in fair condition (and buildings erected a generation or more ago were generally built for hard usage and had a good foundation) it can be salvaged and yield a high rate of return on the investment. The general principle is to place a new stucco exterior over the old weatherboarding, "overcoating" as it is termed, and thus save the building from further depreciation and upkeep for painting. If the siding is loose and shaky it may have to be removed or renailed, otherwise the metal lath or a similar stucco base is applied over building paper nailed directly to the old siding and the work proceeds essentially as in stucco over sheathed construction.

Almost any type of old building can be renovated at relatively small expense when compared with the results achieved. Nor is overcoating limited to wood frame buildings. Old porous brick or stone walled buildings, painting of which only seems to accentuate their drab appearance can best be modernized by covering them with stucco applied over metal lath. Again, many seekers after a house that possesses individuality and yet is relatively low in cost, deliberately search out some old frame dwelling built in the days of Colonial simplicity and integrity, whose heavy timbers, rough hewn, make a firm foundation for the new exterior that is planned.

Science, also, has uncovered a point in favor of the overcoating, as it has been found to make a house much warmer and comfortable than an uncoated old house which, racked at doors and windows, permits more cold air to enter than can be warmed up to the proper temperature.

There are very good reasons for overcoating an old house and these will be discussed at length under the headings of:

(1) Permanent exterior saves painting costs.

(2) Large items in cost for repairs eliminated.

(3) Overcoating adds to warmth of house and conserves fuel.

(4) Greater attractiveness adds to resale value of overcoated house.

Permanent Exterior Saves Painting Costs

Painting is one of the largest items of upkeep expense in the average building with wood exterior. In manufacturing cities and the surrounding suburbs which, to a greater or less extent, are subject to the smoke evil, it is often necessary to repaint every year. Painting in residential communities remote from manufacturing centers must be done at intervals of two years and not exceeding three years. If this maintenance is permitted to lapse, the buildings will take on a shoddy, unkempt appearance such as is sometimes seen in communities lacking in civic pride.

Such a neglect is derogatory to the best interest of a neighborhood, and will most certainly result in a decline in value not only of the houses of the neglectful owners, but those of their neighbors as well. If allowed to continue, the surface will deteriorate, and eventually serious decay may set in. Painting is imperative if expensive repairs and possible large financial loss is to be averted.

Contrasted with the large amount of wood exterior, in the wood-sided house, which requires repainting, the stucco house has but little that needs attention. This consists principally of the wood trim around doors and windows, the wood coping on porches, the steps, and sometimes the porch floor (although the latter is frequently of cement or brick construction) and frequently the soffits at the eaves. The home owner can himself, readily repaint this comparatively small area every other year, whereas he would contemplate with many misgivings the much larger task of painting a wood-sided house.

Painters, in estimating the cost of painting, consider not only the approximate superficial area, the present condition of the surface, and the colors wanted, but also the accessibility, need for ladders, or hanging scaffold, etc., and usually quote a lump sum for the contract. With the present

An Old Frame House, Built Many Years Ago, at Last Began to Show the Effects of Age and Weather.

After an Overcoating Treatment the Old House Could Not Be Told from a New Stucco Home.

prices of labor and materials it can be safely assumed that the cost of two-coat repainting will approximate 75 cents per square yard. For the average two-story house, 20 by 30 feet in plan and having about 275 square yards of painting surface, the cost will be in the neighborhood of $200.

As against this there will be only 55 yards of trim, soffits of eaves, porch floors, etc., to paint on the stucco house which at a somewhat higher rate on account of scaffolding, etc., will cost approximately $50. This relatively small amount of painting, as has been said before, is frequently done bit by bit by the householder himself. In any event there is a distinct saving of $150. Assuming that this repainting is done every third year the average extra cost per year of painting a wood-sided house will be $50. This, capitalized at 6 per cent, is the annual income on $833.

To put it another way the saving in painting costs alone justifies the owner in spending $833, for placing a stucco overcoating on his house over the wood-sided frame. If he does his own painting of the trim on the overcoated house he would be entitled to a total saving which capitalized would justify an investment for overcoating of $972.

Large Items in Cost for Repair Eliminated

The natural decay, caused by air and moisture, to structures built of wood requires constant expense for maintenance of such parts of the exterior as steps, stair-railings, porch columns, balcony railings, scrolls and spindles under porch canopies. Rotting of the small wood details, mill-cut of the softer woods because of the greater ease of sawing, requires constant patching to insure a presentable appearance.

The use of "ginger-bread" ornament is quite foreign to stucco construction and one of the first principles of overcoating is to eliminate scroll details entirely, remove spindled or slat railings, or replace by solid stucco covered balustrade and cover wood columns, unless of modern construction, with imperishable stucco. The elimination or preservation, under an overcoating of stucco, of the more decayable parts of the exterior thus saves a large amount in repair bills.

A conservative estimate of the amount of such maintenance other than painting required to preserve, unimpaired, the original value of the exterior of a wood-sided house of the dimensions used in the computation in the preceding section of this chapter would be $25. Capitalized at 6 per cent it represents the income on $416. This means that overcoating justifies an expenditure of $416 to eliminate repair bills amounting to $25 each year.

Overcoating Adds to Warmth of House and Conserves Fuel

A continuous overcoating of stucco placed over an old sided house prevents, in a large measure, the leakage around door and window openings, and in the countless other cracks and crannies which open up as a building racks with age. The overcoating stucco construction presents a triple bar to air currents. There is first, next to the old siding, a non-conducting air space between it and the waterproofed building paper. Next we have the wind-tight building paper itself on top of which we have the third barrier, the ⅞-inch solid stucco slab keyed, unbreakably, to the metal lath.

The results of the heat conservation tests made by Professor Peebles, at Armour Institute of Technology, showed that overcoating a house with metal lath and stucco reduces

Before Overcoating, the Residence Above Was Plainly Old-Fashioned and Unsalable, but When Stuccoed, as Shown at the Right, Its Entire Appearance Was Changed and the Modernized Home Found a Ready Market.

the conductivity of the exterior wall by 15.7 per cent with a corresponding decrease in the fuel bill. As the wall area comprises about 85 per cent of the total exposure the decrease in the fuel costs will be approximately 13.3 per cent.

Applying these figures to the residence we have used in these discussions we will save, on the 12 tons of hard coal required to heat an average house of this size, in about the latitude of New York or Chicago, about one and three-fifths tons which, at the present price delivered of $17 a ton, means over $27 a year, enough in itself to pay the interest on the cost of overcoating. Capitalized at 6 per cent it represent the interest on $450.

Greater Attractiveness Adds to Resale Value

The added value given to an old frame house, merely by covering its wood-sided exterior with a stucco covering, seems remarkable when considered in the light of the moderate cost of this improvement. Subconsciously, the buyer of a home weighs the different items of location, appearance, probable upkeep expense and cost of fuel and, on his mental reaction, bases his judgment of its value to him.

The location of the house necessarily remains the same, therefore, as between the old house and its overcoated successor, appearance is the first of the points of judgment which the purchaser is called on to decide. Stucco, as has been pointed out before, blends harmoniously with all manner of landscaping features, with trees, shrubbery, flowers, lawns, garden pools, fountains, pergolas, garden seats and, as it ages with time, becomes an integral part of the landscape and never stands apart from it as houses built of other materials sometimes do.

Then, too, there is the sense of permanence and resistance to external fires which the expanse of stucco surface lends to the whole scene. Therefore, as the prospective owner looks forward to his declining years he naturally hopes to be possessed of a house whose permanence and remoteness to destruction from fire is assured. In this way the real money value of overcoating the old frame house is definitely demonstrated.

Furthermore, there is the matter of upkeep expense. When those who have heretofore been content with paying rent for shelter first contemplate owning a house they are frequently discouraged from attempting a complete investigation by the aspect of the large upkeep expense attendant on the depreciation of the house by time and the elements. These points have been fully considered in the first paragraphs of this chapter, and the large reduction in painting and repair expense of the overcoated house is a pointed argument for the increase in sale value of an old house which has been given a new exterior of stucco.

Coupling with these, the undoubted saving in heating expense, it justifies in the average house we have used in this discussion, an expenditure of over $1,700 for overcoating, a sum much larger than is usually needed. We have altogether a most telling group of arguments favorable to overcoating.

Preparing the House for Overcoating

In the preceding section we have discussed the general principles regarding overcoating old buildings. We have touched upon its various aspects from the standpoint of saving painting cost, eliminating repair expense, conserving fuel and of adding to the re-sale value of the house because of its greater attractiveness.

Overcoating is applicable to houses of all types, whether they be frame, face or common brick, or stone walls, which, as time goes on, sometimes deteriorate to such an extent that the cost of pointing up and painting becomes a burdensome expense. In this section, we propose to discuss the various steps in the overcoating of a house, beginning with an examination of its condition to determine its suitability for this purpose.

Examination of Old Foundation

For the frame house, it is most important to ascertain the condition of the foundation. If it is some form of masonry, the problem is quite simple, as such foundations are most permanent and generally in excellent condition as far as load bearing is concerned. However, if settlement has occurred unequally, and it is serious enough to detract from the appearance of the building, it will be good policy, if the building is valuable, to call in an experienced building mover and raiser or foundation expert who can suggest ways and means of shoring and raising up the settled portions.

Repairs to Old Masonry Foundation

If stone or brick has been used, it sometimes happens that, although it is amply safe as far as load-bearing is concerned, it has weathered, the stone has chipped, or the mortar has worked out of the joints, presenting an unsightly appearance. This can be remedied by filling all the bad joints with mortar or by placing a new concrete base face over and bonded to the masonry for a distance of about twelve inches above the ground, and for a depth of about six to nine inches below ground. It need extend downwards no more than this, but to take care of the uplifting effect of the frost, the bottom of the extension should be beveled up and away from the foundation. Bonding of the new concrete to the old is best effected by raking out the old joints and driving into them heavy spikes at intervals of about two feet along the wall.

When an old masonry wall extends more than twelve inches above grade, the new masonry base added need not be carried higher than the twelve inches, as the stucoo on metal lath overcoating, over the siding or old masonry above, can be carried downward to the top of the new masonry base and thus present a uniform appearance for all of the stucco. In this event the metal lath can be attached to the masonry by nailing into wood plugs, driven at intervals into the joints, or with heavy brick staples or by the new hardened masonry nails.

Foundation of Wood Sills and Posts

Where a building has been built on wood sills or posts it is very essential that these be examined to see that they are in satisfactory shape before proceeding. Charles E. White, member American Institute of Architects, has written instructively on this important phase of the problem. He says in part:

"Make a complete examination of the house from cellar to garret. If you haven't confidence in your own judgment, get a practical architect or builder to make the inspection for you.

"There are several vital spots where decay is apt to begin. First in the sill. This is that timber, resting on the masonry underpinning, which supports the first-floor joists and wall studding. It is the undermost timber of the house, and bears the same relation to the house that a pair of shoes does to a man. The entire weight of the building above ground rests upon it. For this reason the sill should be carefully inspected. Dig a knife blade into it to see if the fibers show signs of dry rot or decay. Sound timber will resist a blade like new wood. If the wood is decayed a blade will easily enter its soft substance.

"It isn't often that the sill is in bad shape; but sometimes, when the water-table outside (that lowermost board just above the underpinning) has not been kept in good repair, water runs in and dampens the sill. The alternate dampening and drying of the timber causes it to rot.

"If the sill is decayed in spots, and not through its entirety (the latter is rarely the case), it may be repaired as good as new.

"Simply saw out the soft places and insert new sound pieces. After sawing out the decayed wood, "halve" the joints or cuts. That is, saw out the bad place, but, instead of leaving the cuts vertical, trim them to a wedge shape or half joint so the new timber when inserted will bond with the old. Spike the ends well, and your sill will be as strong as it was originally. Any first-class carpenter can do this work without disturbing the floor joists or studding above."

Condition of Old Exterior Wall Studding

With the foundation repaired in good shape, the outside studding should next be inspected carefully. Especially attention should be paid to the ends of the studs where they rest on the sill to see that these ends have not rotted. The same test can be applied as that given by Mr. White in the examination of the timber sills. Splicing the bottom of decayed studs with new timber is done by nailing or "scabbing" on new studding for a distance of two feet or so, then cutting off all the decayed end of the old stud and replacing with a new piece driven to a driving fit between the cutoff and the sill, and nailing to the "scabbed" on piece.

Another essential point is to be sure that the outer wall studs have not buckled or sagged out of line. This can be determined by taking a straight edge ten or twelve feet long and applying it to the inner and outer faces of the wall. Surfaces out of plumb and line will show up quickly. Deformations such as this are generally caused by the unequal settlement of the foundations or by rotting and consequent giving away of the studding. In order to have the stucco present a plane surface and, therefore, one most economical of stucco materials, it is quite important to have the studding line up. Methods of bringing this about are frequently very simple and the practical architect or builder can be depended on to devise an economical solution in each case.

Condition of Interior

Before proceeding with the discussion of the other details concerned with overcoating the exterior, it might be well to touch on some of the other aspects of the remodeling problem, which are of sufficient importance, as they affect the general problem, to warrant a slight mention here.

Specifically, the condition of the interior details of the old house should be inspected, in connection with that of the exterior wall, to determine whether they warrant the expenditure required to improve the building. Unless the building is in fair shape so that extensive alterations and repairs are not required to remedy fallen plaster, sagging floors, marred doors, worn-out woodwork, bad plumbing and ancient lighting fixtures, it is hardly advisable, unless for sentimental or special economic reasons, to spend money on overcoating, when a new building is really needed.

Taking Sag Out of Floors

The reliable building constructor, however, can correct many common ills which old houses are heir to by simple and inexpensive expedients. A sagging floor can be remedied by building a new girder under the sagged part and supporting it on new masonry or wooden posts or piers in the basement. Each sagged joist should then be brought to a common level by driving wedges between its bottom edge and the top of the new girder. If jackscrews are available, the method indicated is to jack up the sagged joists to a position slightly above level (say, ½ inch or less, depending on the span) place the girder on its supports tightly under the joists in their raised position and then remove the jacks when the floor will settle down to a level position tight against the girder.

Sagging of upper floors is more difficult of correction and in general it is not practical to attempt alteration of the supporting joists.

Floors normally have reached their final position in old buildings and further settlement need not be looked for. Remodeling is best effected by laying a new finished floor on top of the old one, placing in between them thin strips of thickness to correspond to the sag at the various points on the floor. The desirability of having new hardwood floors, when a general remodeling of an old house is contemplated, is quite universally recognized, as with the exception of lighting and plumbing fixtures, no parts of a building show obsolence and depreciation more than do the floors.

Metal Lath and Plaster Used for New Ceiling Construction

A suggested method to eliminate unsightly ceilings which have sagged and where large quantities of plaster have fallen, is to construct a new ceiling of lath and plaster attached direct to ceiling joists after the old lath and plaster have been torn off. Where the ceiling joists are considerably out of level it may be advantageous to construct an entirely independent suspended ceiling below the original one, which will hide the unevenness. The use of metal lath in remodeling interior walls and partitions is recommended because of its adaptability in reinforcing the plaster to prevent cracking.

In well built buildings the cost of remodeling is materially lower than for those of flimsy construction, and in conjunction with a new stucco overcoated exterior the remodeling will in the degree commensurate with its thoroughness add measurably to the appearance, desirability, and value of the entire building. Remodeled buildings have many times made fortunes for their owners, whereas, in their previous dilapidated and antiquated condition they have been a source of constant loss and increasingly high cost for upkeep and repairs.

Having discussed at some length a few of the elements entering into the consideration of the problem of remodeling and overcoating, we are now prepared to go further in the discussion of overcoating details.

Reconstruction of the foundation walls and supports where necessary for the purpose of stucco overcoating and realignment of the outside studding having been provided for. The next question is whether the old lap or cove siding, clapboards, or shingles need be removed before placing the new base for stucco. Each building is a problem in itself and must be decided on its own merits. Where the old wall covering is in generally good shape nothing need be done other than going over it and nailing it down where it has come loose, replacing with new materials only in such places where decay has set in to a large extent.

When, on the other hand, painting has been neglected for a long time and the siding or shingles have rotted, fallen off, or are in a generally bad state of repair, it is best to remove all of the exterior covering, right down to the sheathing. In this case, the sheathing should be covered with building paper and, after placing metal flashing over horizontal wood surfaces where water might collect and get behind the new stucco. The various details of applying the furred-out metal lath over the paper, stuccoing, etc., are the same as given in previous chapters dealing with stucco over sheathed construction.

Extension of Door and Window Trim

In the more general case, where the old siding or shingles are in good condition, construction is carried on a little differently. First, the increased thickness of the wall necessitates extension of the trim around the old windows and

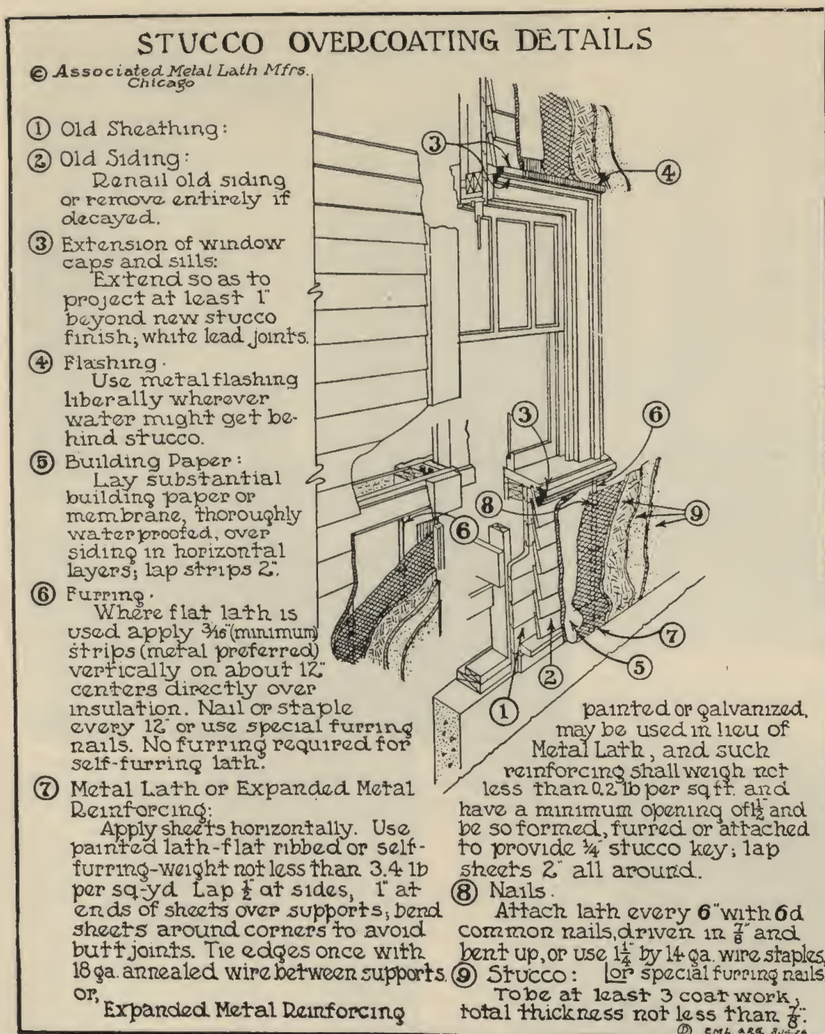


Fig. 19. Details to Be Observed in Overcoating.

as the stucco base around the old masonry chimney it is well to flash and counterflash the joint between it and the roof.

After the old siding has been securely nailed and repaired, and extensions built on to door and window trim, the necessary alterations of the porches, balconies, columns, and other details required to conform with the simplicity of outline of the stucco house should be made. At small expense it is quite frequently possible to transform an old decaying shack into something of architectural beauty really worth while. Here the retention of an experienced architect will more than justify his compensation.

In general all scroll mill work, and other wood members such as balcony and porch railings subject to more or less rapid decay should be moved and replaced with more permanent materials or they can be permitted to remain if protected by a stucco overcoating.

Other details which require attention and should be put into first class shape before going ahead with the application of the metal lath, are roof gutters and down spouts, which should be permanently hung and so placed that there will be no break in the stucco surface where they are fixed, and no discoloration should a leak develop in the gutters or spouts. Other fixed supports and fasteners should also be put up at this time.

Having successfully completed the task of structural reconstruction and rehabilitation the next step is to proceed with the attachment of the metal lath. First, however, it will be necessary to apply at least one coat of waterproof building paper over doors so that they will project beyond the face of the new stucco. Occasionally, it is true, the stucco is carried over the old trim in a manner so as to produce a recess or revealed window or door, but this method is not common. The construction much more frequently used is to maintain the relative projection of the present moulding beyond the face of the siding by the addition of new material to the original moulding and trim. This is shown at 3 in Fig. 19, also in Fig. 20.

In extending the trim and moulding around door and window openings, it is highly essential that joints between the two, where water is apt to collect and possibly be carried up behind the new stucco to freeze and crack the surface, be properly covered by metal flashing. An instance in hand is the cap over a window and in Fig. 20 is shown one satisfactory method of attacking this problem.

The metal flashing must be rust-resisting, such as galvanized steel or zinc sheets, and be nailed to the old siding, bent down to cover the joint and then be carried down and around the new cap extension with a projecting lip to act as a drip. Places similar to this are also found where the chimney and roof intersect. Before placing metal lath

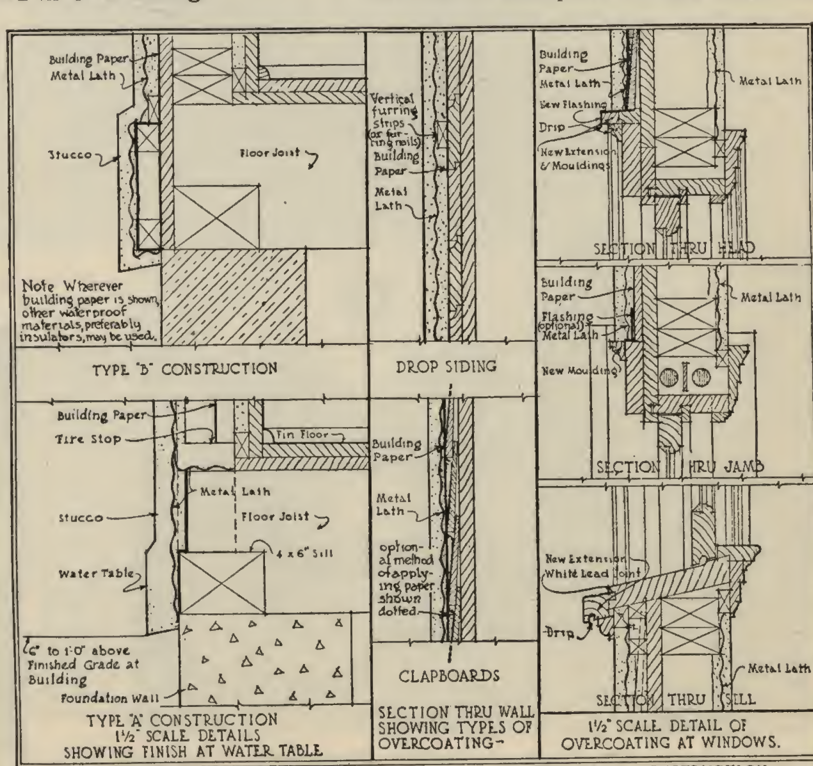


Fig. 20. Correct Method of Applying Stucco Base for Overcoating.

the old siding to act as a wind stop and as a base against which to apply the stucco. It is important that the building paper be waterproof and properly lapped so as not to absorb the liquid element in the stucco which is so essential to its proper set (hardening). At the same time the paper acts as a backing, pressure against which causes the stucco to spread and cover the back side of the lath.

On lap siding, clapboards or shingles, the paper may be applied so as to conform approximately with their surface contour, and in this case it is then feasible to apply lath directly over the paper without using furring strips or self-furring lath. See Fig. 20 for details. However, if the paper is stretched tightly over the siding, or if the overcoating is placed over drop or cove siding furring of some type will be a necessity, as the back side of the metal lath must be embedded in stucco to conform with standard practice, and this is not possible when furring is omitted.

After paper and furring are in place, flat lath is next applied, and nailed or stapled over the furring and on to the old siding, or else self-furring lath is used directly over the paper and similarly attached to the siding. The building is then ready for stucco but before proceeding it will be advisable to paint all wood surfaces.

Fig. 22. This View of the Dining Room in the Apartment of Alfred C. Bossom, New York City, Shows the Use of the Arch Over the Window Opening.

Fig. 21. In the Home of English Design, F. J. Foster, Great Neck, L. I., Architect, Is Seen the Application of the Curved Arch to Various Openings.

Arched Doorways and Niches and How They Are Built

Now that Spanish, Italian and Mediterranean architecture is in vogue, with their marked influence on modern architectural design, both exterior and interior, we find that arched doorways and arched recess panels for bookcases and other closets quite frequently bring up construction problems which the builder is called on to solve.

There is hardly need of repeating that at a very slight expense much individuality can be given what would be otherwise a plain interior, by the use of arched openings. Indications of their adaptability and the many ways in which they can be used to beautify a home is shown in the illustrations.

Fig. 22 shows the use of an arched window opening which appears in the apartment of Alfred C. Bossom,

Fig. 23. Wide Arched Openings in the Residence of H. H. Service, Detroit; Richard Marr, Architect.

Fig. 24. A North Italian Interior Showing the Use of Arches for the Recessed Bookcase and, to the Left, to Harmonize the Flat Topped Doorway Entrance.

Fig. 25. Construction Detail for an Arched Opening.

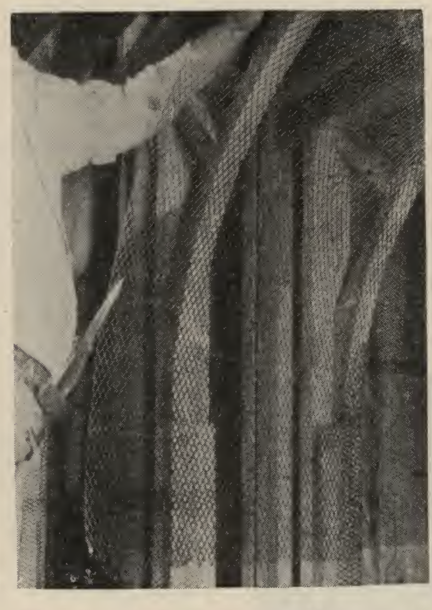


Fig. 26. Application of Metal Lath to an Arched Opening.

Fig. 27. Application of Corner Bead to an Arched Recessed Bookcase.

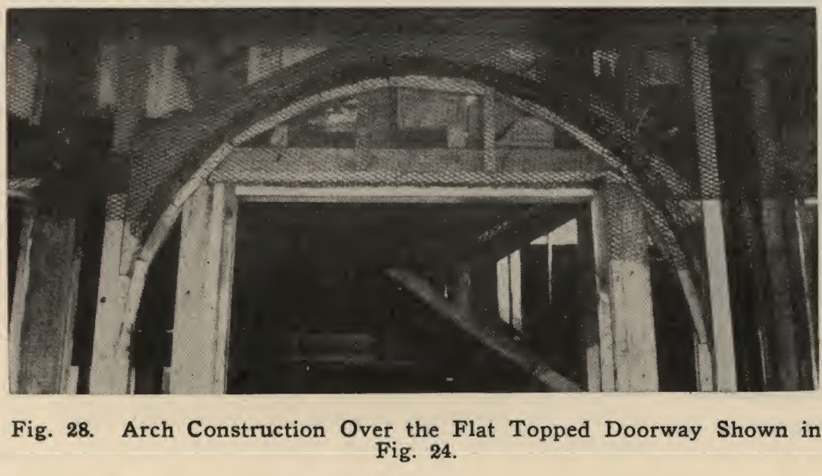


Fig. 28. Arch Construction Over the Flat Topped Doorway Shown in Fig. 24.

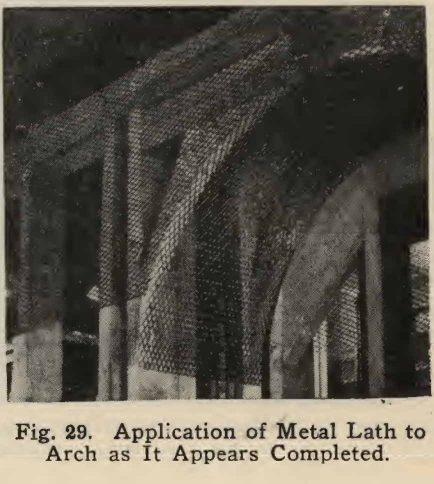


Fig. 29. Application of Metal Lath to Arch as It Appears Completed.

New York City architect. It is one of the outstanding decorative features of the dining room.

Quite unique are the arches used under and as part of the main stairs in the modern home, Fig. 21, designed by Architect F. J. Foster, of Great Neck, L. I. This house is of English design. Fig. 23 shows a large arched opening between the living and dining room in the residence of Mr. H. H. Servis, Detroit, Michigan. The architect was Richard Marr.

Arched recesses in walls such as niches for vases and for bookcases are also being favored. The bookcase in the center of Fig. 24 is one example. Attention is also called to the slightly recessed plaster finish in the form of an arched opening which is built around the stairway shown near the left-hand side of the picture. These are mentioned because their construction will be described in greater detail.

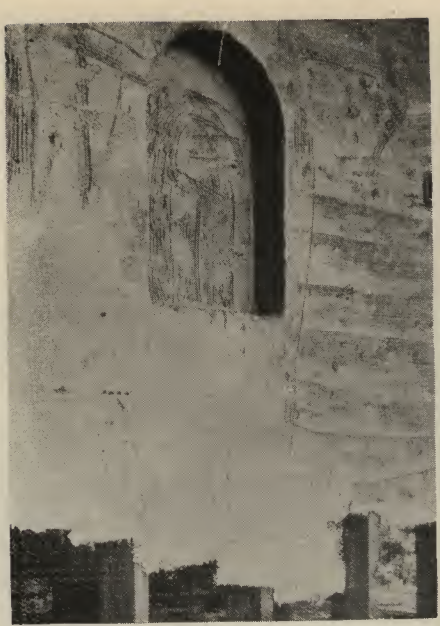


Fig. 31. Construction of a Curved Top Wall Niche for a Vase.

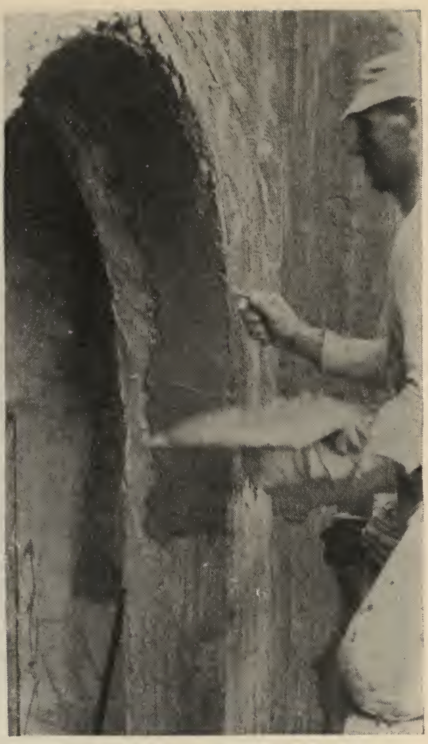


Fig. 32. Plastering an Arched Opening.

Regardless of the plastering base which may be used in other parts of the building it has become universal practice to use only metal lath for arched openings such as we have described. This follows because it is readily formed to the proper curvature, is quickly attached to the framing and at the same time provides a very satisfactory reinforcement for the plaster finish.

The first step in making such arches is shown in Fig. 25, where are shown the curved pieces in place. These are cut on a band saw in accordance with the architect's template. The center point of the curved pieces are usually stiffened in order to provide substantial nailing surfaces and they are then lathed with metal lath as shown in Fig. 26.

Note how these sheets of metal lath are cut at the side and bent around the corner so as to provide an unbroken plaster reinforcement for the edge of the curved opening.

Fig. 30. A Curved Top Wall Niche, as in Figure 31, as It Appears When Finished.

There is also shown the lath around the opening as illustrated in Fig. 29. Note also the doubling of the studs adjacent to the door opening, in order to take the load off the arch and preserve uncracked plaster soffits. This opening is now ready for the plasterer.

Fig. 27 shows cornerbead reinforcing the edges of the opening in the construction of the circular top bookcase shown in Fig. 24. Closeup detail showing the method of cutting the cornerbead so as to follow the curvature of the arch is shown in the inset. Fig. 28 shows a detail of the application of metal lath to the circular plaster reveal around the flat top door opening shown at the left in Fig. 24. Note how the short pieces of wood have been cut to conform to the approximate curvature in order to form a backing for the metal lath nailed over it. Inasmuch as the plaster reveal was given a curve in plan, it was not feasible to use cornerbead which is usually recommended for the purpose.

Fig. 32 shows the plasterer in the process of putting on the brown coat plaster for an arched opening. This requires skill and care but with the background of metal lath properly applied the work is not as difficult as it might seem at first glance. Arched niches are quite readily built into the wall as indicated in Fig. 31 and add a distinctiveness to the design out of proportion to their cost.

One advantage that should not be lost sight of in the construction of arched openings is the opportunity they give to indicate massiveness of construction which is particularly called for in Spanish and Italian design. From the details which have been illustrated herewith it will be seen that this construction is entirely practicable and that there are no special difficulties to be overcome.

However, it is important to observe that an arched opening built into a wood stud wall should not be expected to carry any load from above. This should be taken care of by properly trussing the opening so as to relieve the plaster arch entirely.

It is customary in the case of arched doorways, etc., to omit all wood trim ordinarily used around door openings, so that the protection afforded by cornerbeads should be resorted to. They also insure straight, sharp corners.

Permanent Stucco of Portland Cement on Metal Lath

By JOHN ROBERTS
Chief Plaster Inspector for the City of Minneapolis

METAL LATH and portland cement stucco has been common practice in Minneapolis for more than twenty years. During all of that time it has grown constantly in popularity. There have been very few failures. In fact, in the seven years I have been Plaster Inspector there have been only about three failures in thousands of jobs. Today ninety-five per cent of all the buildings being built in Minneapolis are of portland cement and metal lath exterior.

There is no question that metal lath and portland cement, properly applied, is permanent. There is no question that properly reinforced portland cement will withstand the movement of a reasonably good frame, steel or masonry building.

The four things necessary to a good job, one can see at once, are as follows: A reasonably good building, free from excessive movement of any kind, including shrinkage and settlement. Second, proper lath, properly applied. Third, sufficiently thick cement (that is, the stucco must be at the very least three-quarters of an inch thick). Fourth, proper ingredients (that is, clean sand, enough cement, but not much, etc.) All of these details properly attended, one may be sure of a permanent job of stucco.

You know cracks in stucco are caused by three faults. Two of these are in the stucco itself (or lath), and the third is caused by outside influences. First, the stucco or cement itself may be at fault, through dirty or otherwise poor sand, or too rich a mix (map cracks) or too poor a mix, or dry outs, or other causes existing in the mixing, ingredients or application of the cement itself. Second, the lath may crack the stucco, if wood lath or other moving material is used. Or the lath may fail to reinforce the stucco against the slightest movement of the building, by presenting long unbroken joints over the studs, etc. All of these failures of lath and plaster can easily be avoided in the plastering itself and the lath. But the last cause of cracks, movement of the building, is beyond the plasterer's control. Of course, a metal lath reinforcing will both strengthen the building and distribute the strain to prevent any reasonable amount of movement from cracking the plaster. But if the movement is excessive it will crack any plaster, brick, stone or any other veneer.

Introducing an Outstanding Authority on Metal Lath and Portland Cement Stucco

Mr. John Roberts, Chief Plaster Inspector for the City of Minneapolis, has had very exceptional opportunities to study portland cement stucco on metal lath. Mr. Roberts learned the business of plastering as an apprentice and afterwards as a journeyman plasterer. He found time to attend the University of Minnesota, and is familiar with the chemistry and scientific reasons for reactions. He contracted plastering for several years prior to his entrance into the World War. Upon his return from the army seven years ago, he was appointed Plastering Inspector of the city of Minneapolis. Since that time he has examined many thousands of jobs of stucco on metal lath. The uniform success of this construction in Minneapolis is evidence enough of his efficiency as an Inspector and his knowledge of the proper materials and practices.

Types of Lath

Metal lath, or other metal reinforcing, is the ideal plaster base. In Minneapolis, the common practice is diamond mesh self-furring lath, 3.4 pounds 24 gauge painted or coated with other rust resistant material. Galvanized lath is the common practice. Of course, wide mesh lath, and wire are recommended, but seldom used in Minneapolis. If they are of sufficiently heavy metal, mesh wide enough to assure the proper imbedding of the back of metal, and rust resistant, they are all good.

General Rules for Applying Metal Lath

The methods commonly used for attaching the lath to the building might be divided into three general classes:

1. Attaching lath direct to the studs. If this is done in Minneapolis, we require that it be back-plastered, this back-plaster to be at least an inch thick.

2. Furring strips. Flat lath cannot be used over sheathing or other solid backing without furring strips. It must be furred out, or self-furring lath used to assure the burying of the lath. Furring strips may be crimped metal, wood lath or other wood strips, or metal pencil rods. The trouble with furring strips is that they cause thin streaks through the panel of cement, weakening it along the line of the strip.

3. Self-furring lath and self-furring nails. These, of course, presume a backing for the cement, sheathing or stiff boards of some kind.

Minneapolis has used from the beginning, years ago, the self-furring lath, with uniform success. Although there is no law against furring strips, or back-plastered jobs, they are not commonly used, and I personally think that self-furring lath, or the self-furring nails are the best practices.

Details of Lathing

Lath must be lapped at all joints, at least two inches at ends, and at least one inch on sides of each sheet. Lath must not form joints at corners or angles, but must carry past such angle or corner at least twelve inches.

The type of nails used is important. In Minneapolis we require staples. Over sheathing, staples are one inch, 14 ga. galvanized or blue. Direct on studs staples are 1½ inch 13 ga. galvanized. Self-furring nails are also recommended where practicable. Common nails, half driven and then bent to hold the lath, are bad practice, first because there is no assurance of the depth to which they will be driven, and second, there is greater danger of careless breaking of the strands of the lath by hitting too hard.

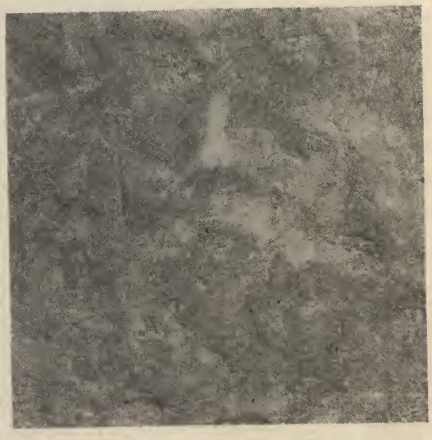
In driving the staples, drive them in, do not bend them over. Do not drive the staple completely home. Leave it out one-eighth of an inch or so. This accomplishes three things: First, it allows for some movement in the building behind the stucco; second, it becomes buried in the cement, and acts as a permanent anchor; third, it avoids danger of breaking the lath strands.

SIX STEPS IN PRODUCING "CALIFORNIA FINISH"

1. The Finish Is Applied on Either Waterproofed or Unwaterproofed Second Coat.

2. It Is Laid on Heavily with Irregular Strokes of the Trowel.

3. The Final or Third Coat, Ready for Finishing to Produce that Popular California Finish.



4. The Finish Coat Is Worked Down as Shown Here with a Rough Cloth Such as Burlap.

5. The Last Step Is Floating but the Surface Is Not Made Entirely Smooth.

6. It Is Left with the Slightly Irregular Surface Familiarly Known as California Finish.

Over sheathing the staples, or nails, must be driven at least every twelve inches horizontally and six inches apart vertically. When nailing the lath direct to studding, the staples must be every four inches.

In Minneapolis the frame buildings are papered outside the sheathing. This paper is nailed on with small blue nails, and tin washers. A paper prevents the wood from sucking the moisture out of the stucco. It protects the wood also. Asphalt paper is safer, as some of the cheap tar papers contain corroding elements. If paper is used it is a better practice to nail it on as described rather than to use strips, and so weaken the panel of the stucco.

Whatever type of lath is used, and whatever system of nailing, the lath should be completely buried in the cement. Sufficient pressure, and sufficiently wet mix in the scratch coat is necessary. This method, over any stiff backing such as sheathing, presses the cement flat against this backing, and causes a complete covering of the back of the lath. This not only gives greater strength to the stucco, but protects the back of the lath from exposure to moisture.

The Plaster Scratch Coat

Proportions for the scratch coat are one part of cement to two and one-third parts sand, by volume. Hair or fibre binder should be used, not too much, but sufficient to hold the mass together. Usually one bushel of hair will suffice for one hundred yards of stucco. Long winter cow hair is recommended. The hair must be soaked and beaten until entirely separated. It must be mixed thoroughly with the cement.

No lime is recommended in the scratch coat.

No waterproofing is recommended in scratch coat, except where the browning and finish are applied at the same time, such as travertine.

This first coat must be mixed wet enough to push through the lath readily, and completely imbed it.

The first coat must be thoroughly roughed while it is wet. A piece of metal lath will do to scratch it with, and metal combs can be had, made for that purpose. It must be scratched deep, in every direction. The mechanical bond of the second coat depends entirely on the proper roughing of the scratch.

This scratch coat must stand until it takes its initial set, not necessarily until it is dry, before the second coat is applied. This initial set takes twenty-six hours.

Second Coat or Browning

Proportions of mix, one part cement to one and three-quarter parts sand, by volume. No hair or other binder is necessary, and no roughing other than floating.

No lime should be used in the second coat, especially if colors are to be used in the finish coat, as the lime will stain or bleach the colors.

All leveling and truing must be done with this second coat. It must be level and true, but not smooth. Flat it, don't trowel it, to receive the finish coat.

The second coat must set until dry, until all internal stresses have developed, before the finish coat is applied. It takes about seven days for this set to take place.

The proper uses of waterproofing, and the reasons, are given further on. The proper waterproofing of the second

coat is most important, and depends on the finishes to be used. To avoid repetition, we give all of these rules in one place, under "Waterproofing."

Dampening

This second coat must be wet down every day. But be careful not to wet it until the initial set has taken place (26 hours).

Slobbers and flat spots in rough cast are always caused by one of two things. Either the second coat was too wet when the finish was applied, or the doubling up was done too soon after grading in.

For light colored sand floats and texture finishes, have second coat wet when finish is applied. If second coat is not too waterproof some of this moisture will be absorbed and gives off little by little as finish coat drys.

For dash coats, second coat may be dry when finish is applied.

Third Coat

Proportions: If second coat is waterproofed, one part cement to two and one-quarter parts sand by volume. If second coat is not waterproofed, one part cement to two and three-quarter parts sand by volume. (The reason for permitting a richer mix in case the second coat is waterproofed is this: Richer cement map cracks more easily. The danger of map cracks is increased by the suction of a non-waterproofed under coat, so the mix is made leaner.)

Not over 10 per cent of lime helps the finish coat, especially when natural light colored cement is used.

Waterproofing

Before discussing the various finishes, which depend much on the proper use of waterproofing in the scratch and brown coats, we may as well dispose of the subject of waterproofing.

Stucco is applied in extremely thin coats, as cement goes. Matters of suction, wind drying, etc., which would in no way affect mass uses of cement, are deciding factors in stucco work.

Unwaterproofed scratch and brown coats suck the moisture out of the following coat. If the following coat is heavy, as when the heavy second coat is added over the scratch, this suction does not dry out or harm the new coat. On the contrary, it acts as a sort of reservoir, giving the moisture back into the new coat, by capillary action, as it is needed and as the set progresses.

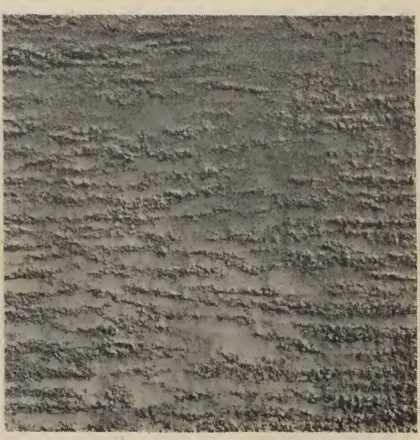
But where the following coat is thin, as with flat coats, etc., then the suction of the coat beneath destroys the set, drys out the new coat, and ruins the job.

Waterproofing should never be added in sufficient quantities to prevent the proper cure of the cement. Too much waterproofing may even tend to prevent the waterproofed coat from absorbing sufficient moisture to set properly. Of course, this causes stucco of low tensile strength, subject to stress cracks.

Wherever waterproofing is used in an under coat, a richer mix is permissible in the finish coat, for the danger of map cracks is lessened, because the drying out of the finish coat due to absorption by the brown coat does not take place. The finish coat stays in a plastic condition longer, stiffens more slowly, and thereby lessens the danger of the map cracks. This is the reason for heavily sanding stucco to be used over tile that has suction.

SIX STEPS IN PRODUCING "TRAVERTINE FINISH"

1. For Travertine Finish a Heavy Waterproof Is Used.
2. The Texture Is Secured in a Heavy Second Coat.
3. Only Two Coats Are Used for the Travertine Finish.



4. By the Use of a Whisk Broom This Texture Is Obtained
5. The Surface Is Then Worked Over with a Float.
6. The Result Is the Well-Known Travertine Stucco Finish.

Finishes

Generally speaking, thin third coats such as floats, require a waterproofed second coat. The reason is that these floats must be as thin as possible to work right, and to prevent map cracks. Too much suction compels too heavy a finish, and a limited amount of waterproofing remedies the trouble.

For spone, stipple or other pulled surfaces, waterproof the second coat.

For float coats, or for thin laid on coats, waterproof the second coat.

For rough cast, oak leaf or other heavy laid on finishes, and for rough troweled or other heavy finishes, waterproofing may be or may not be used. Remember, the mix must be more heavily sanded if waterproofing is omitted.

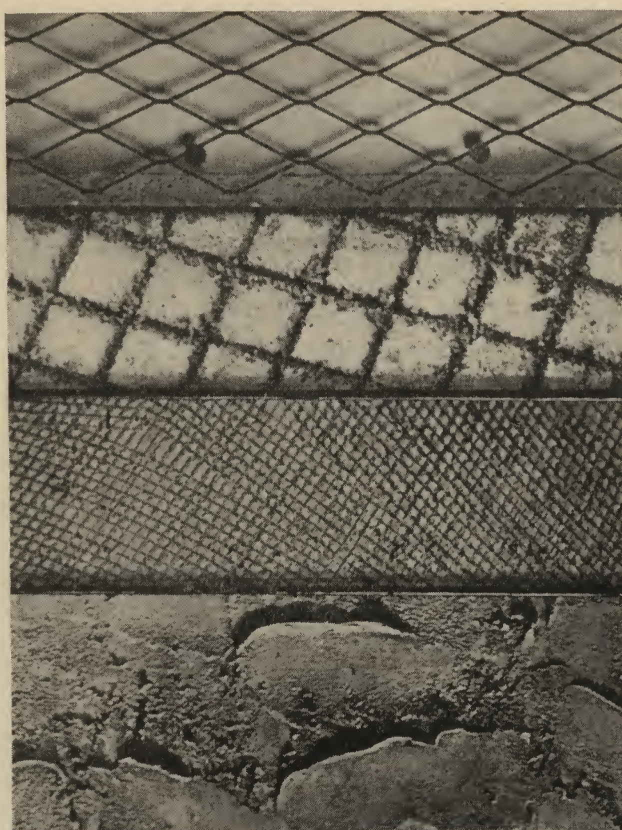
For rough coat, after finish has set for twenty-six hours, wet it several times with fine spray. It will discolor if wet sooner. Also it will discolor if brown coat is not thoroughly dry when finish is applied.

For rock exposed surfaces, waterproof the scratch coat. Lay on heavy scratch coat and very heavy second coat. Throw the stone into this second coat, and press it in.

Travatine and other similar finishes, over a heavy, waterproofed scratch coat put a heavy second coat, and get the texture in this second coat.

For heavy rough trowelled finishes, corded effects, apply the finish desired over either waterproofed or unwaterproofed second coat.

Oak leaf, and other most attractive effects are gotten as follows: These finishes may be applied direct over waterproofed second coat, or duotone effects may be gotten by floating one color over the second coat, and adding the texture in another color. One common method is to dash the color on, then with a trowel flatten out the dash into the texture desired, leaving the under coat partly exposed.



Here Is Illustrated the Four Steps in a Complete Stucco Job. At the top the metal lath applied to the wall and below the first, second and finish coats of stucco.

In this article all proportions are given by volume, rather than by weight. Sands vary in weight, and volumetric comparisons are safer.

Mix every batch thoroughly. Thorough mixing is every bit as important as proper ingredients.

Mix only enough at one time to do for about an hour's work.

Do not re-temper. Dry mortar, caused by suction or evaporation, may cause the mass to become stiff, when no set has occurred. In this case to moisten and work it over does no harm, for this is not re-tempering.

Sand is all important. You must have a clean, sharp coarse sand to get a good mortar. Three simple tests are given to enable you to determine the fitness of your sand. There is no excuse for spoiling good stucco with poor sand.

Clean Sand: To test sand for vegetable loam or other deleterious foreign substances, take a one pint bottle or jar. Fill this one-quarter full of sand. Then fill it two-thirds full of a 2 per cent solution of sodium or potassium hydroxide. Shake until liquid is thoroughly through the sand. Allow to stand over night. If the liquid is clear in the morning, the sand is clean. Any reddish color denotes impurities which will weaken the mortar.

Coarse Sand: All of the sand must pass through a screen four meshes to the inch. (This, of course, does not mean a quarter-inch mesh, as the wires take space, openings about 3/16 inch.) None of the sand should pass through a screen 8 meshes to the inch.

Sharp Sand: Sand should be sharp, not round like marbles. If you are not accustomed to judging this quality of sand by rubbing it in the hands, then use a magnifying glass.

Clean, coarse, sharp sand is so essential to good stucco that it is worth all the trouble you may take to get it.

Cement, to set, needs moisture, for at least twenty-eight days. Veneer walls, stucco, present such a large area to the sun and wind in proportion to the mass of the cement, that they will dry out unless carefully protected. The moment absence of moisture is complete, after the set has once started, the set stops, and cannot be started again. Keep the cement wet, each coat, but do not apply moisture until after twenty-six hours. Work inside on dry, hot, windy days, and do your exterior stucco when the weather is cool and damp. If compelled to work in the hot winds, very exceptional precaution must be taken to keep the cement wet. If it is so hot that a dry out occurs inside of the first twenty-six hours, before moisture can be applied, there is no chance for a good job.

All places where the stucco meets any other construction should be flashed, that is, porch roofs, sills, etc. Moisture pouring behind the stucco itself, but it soaks the wood, and is generally disastrous. Another wise and inexpensive precaution is to rabbet or strip all window sills and other returns, to act as a drip.

If stucco is carried clear to the ground, be very sure that the lath is completely imbedded, and the stucco very heavy. Anti-freeze is never recommended.

In early spring and late fall, rough coating should be stopped by three o'clock in the afternoon, for if the moisture is not thoroughly absorbed or evaporated by sundown discoloration follows.

Various reasons are given for the long years of uniform success with metal lath and stucco in Minneapolis. Probably the one greatest factor is the materials used and the methods of application.

For instance, there is much sound merit in the method of attaching self-furring metal lath over a solid background. There is no light lath used, no flimsy nailing, because the building ordinance covers this, and a sufficient inspection department enforces the ordinance.